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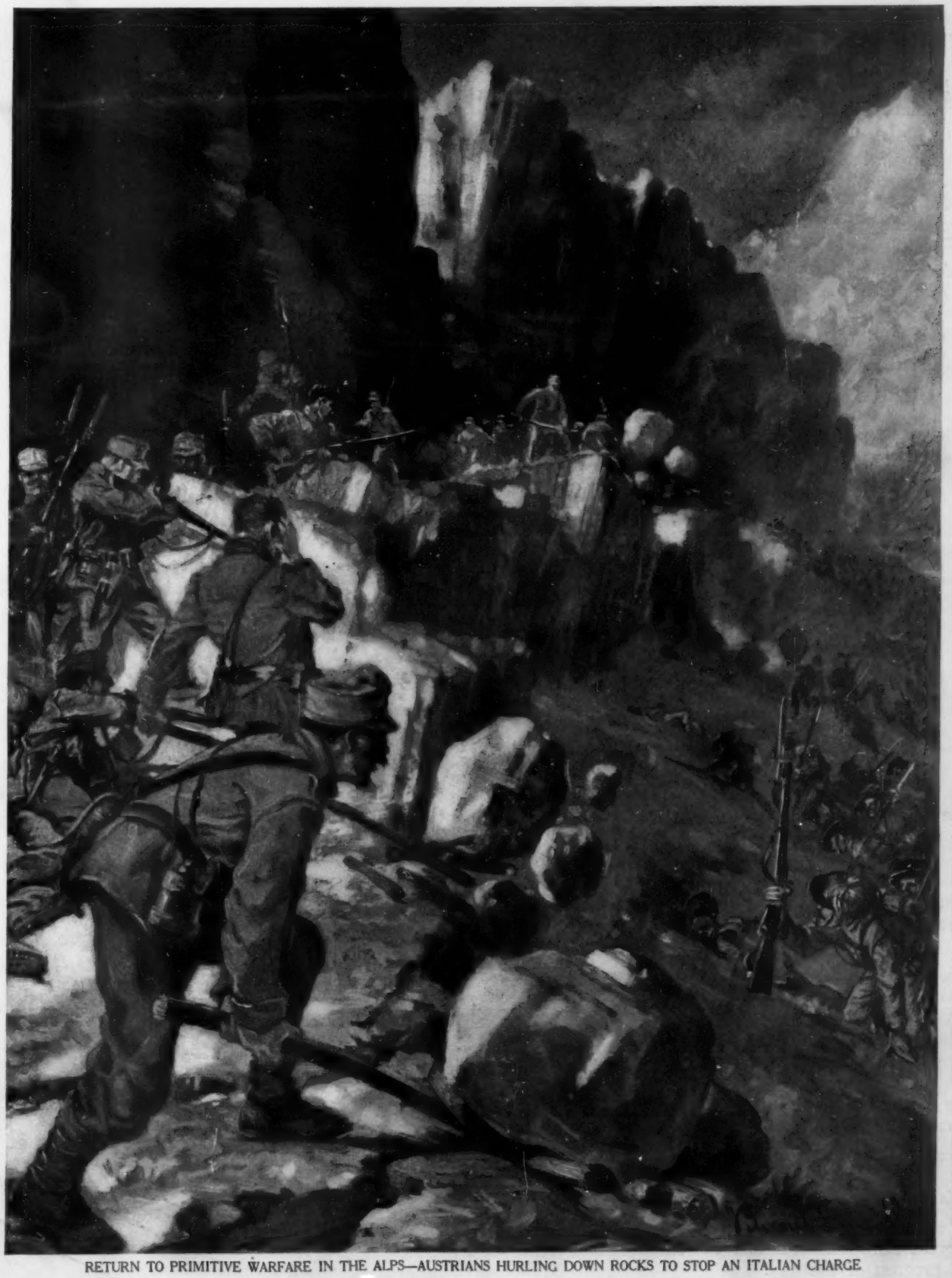

RETURN TO PRIMITIVE WARFARE IN THE ALPS—AUSTRIANS HURLING DOWN ROCKS TO STOP AN ITALIAN CHARGE

Vol. CXIII. No. 21
November 20, 1915

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SCIENTIFIC AMERICAN
ELECTRICAL NUMBER

December 4th, 1915

THIS number will be of unusual value to readers of the Scientific American and to all who are interested in electricity. It will not be a review of past developments but will deal with matters of the present day and will point to the future progress.

Hitherto we had depended altogether too much on Nature's stores of energy in the shape of coal. Except for hydraulic power we have used very little of the other sources of energy, namely the winds, tides, sun's heat, etc.; even the water powers have been used to a very limited extent. What the future holds forth when all these sources of power are utilized is discussed in a very able article by a prominent electrical engineer.

The other day the human voice was heard from Honolulu to Paris. It was the most marvelous electrical achievement since Marconi flashed his feeble three-dot signal across the Atlantic. Is a new era of communication dawning? Will man be able to girdle the earth with his voice? These questions will be discussed in an able article.

A very practical subject is the use of electricity in the kitchen. Electrical cooking at the present time has reached a state of development similar to that of the electric light about 1890. Its future is very promising, particularly as engineers are beginning to study the matter from the point of view of the house-holder rather than from that of the manufacturer of the apparatus.

Electricity has played a most important part in the War. Just how great that part is will probably astonish many readers of this electrical number.

In addition to these articles there will be others on the great European War and the scientific and technical progress of the day.

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If you are still using kerosene or acetylene lamps, it's high time you changed to "Uni-Lectric"—the only light that does not consume the oxygen you ought to breathe. City people have been enjoying electric light and power for years—why shouldn't you have it this winter?

Write today for complete description, and let us demonstrate just how little it will cost to have your home electrically lighted this winter.

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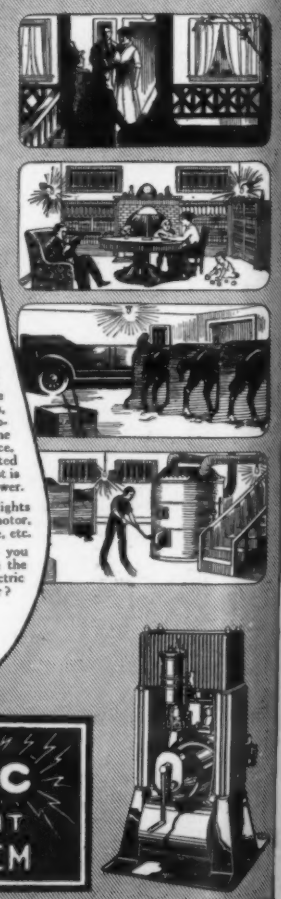

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SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXIII.] NUMBER 21] NEW YORK, NOVEMBER 20, 1915 [10 CENTS A COPY $3.00 A YEAR

Where the muddy waters of the Mississippi are converted into good drinking water for St. Louis

The World's Largest Rapid Sand Filter

WITH a capacity of 160 million gallons of water a day, the new Chain of Rocks filtration plant was dedicated recently by the city of St. Louis, which now claims the largest rapid sand filter in the world. It stands upon the banks of the Mississippi, a low concrete edifice 750 feet long, with extensive settling basins around it, together with a number of buildings which house the apparatus for receiving the yellow fluid of the "Father of Waters" and washing it clean of suspended matter, bacteria, coloring matter and a large proportion of the salts which render it hard and unsatisfactory for laundry use.

When the water enters the two big tunnels from the intake towers it is thick with silt, well populated with germs, hard and generally unfit for domestic purposes. When it emerges from the new filter, it is free from bacteria and has lost not only the mud that gave it a thick and unpleasant appearance, but also the coloring matter of vegetable origin, which could not be removed by settling or filtering but had to be taken out by a chemical, sulphate of alumina.

The cost of the new filtration plant was $1,360,000 and it will guarantee an abundance of palatable and chemically pure water to the citizens. Before the water enters the filters, where it passes through sand and gravel beds, it undergoes an extensive cleaning: first it is allowed to flow through two tunnels driven through bed rock from the channel to a well, after which it is raised to a higher point by six powerful pumps and passed through a settling chamber where the heavy mud and sand sink to the bottom.

Then the water is allowed to race through four long conduits after being charged with lime; the chemical and the swift motion serving to soften the water. Then sulphate of iron is added and the water is turned into a series of big settling basins. The lime and iron cause rapid precipitation of the impurities, so that, after the period of 34 hours in the basins, the water emerges minus more than 95 per cent of its mud and bacteria. The yellow stain of vegetable matter still remains until it is removed by another chemical, the sulphate of alumina. After another settling period the water passes into the sand filters by means of a concrete flume that extends between a series of filter beds. Each of these units is a box of concrete more than 50 feet long, 11 feet deep and 33 feet wide. Each box is divided into three compartments by concrete partitions, a narrow chamber, only 30 inches wide, in which the water enters, and two large ones on either side, which contain the layers of sand and gravel. After being strained through 30 inches of sand and 12 inches of gravel, the water emerges through the strainer plates below, bronze plates with perforations 1-16th of an inch in diameter. By this time the water has no resemblance to the heavy fluid that entered from the river; it is clear and clean and sparkling; but in order to remove any germs that might have survived all this rough usage, a final charge of chlorine is added before the water is pumped to the storage basins.

The chemical controllers of the St. Louis filter plant

Filter boxes, wash water pipe, effluent flume and substructure as viewed during construction

By an ingenious system, the sand and gravel beds may be cleaned in a short time. About once in every day it is necessary to drain the water from one box after another, as the sand and gravel become clogged with impurities and the flow is checked. Then the sand is washed by simply reversing the flow of water, which is forced up from below and agitates the gravel and sand so violently that all the mud and bacteria are removed and the dirty water flows out and back into the river. In fifteen minutes a filter box can be cleansed thoroughly by this process, and be ready for use again. Filtered water is used to wash the sand. The frequency with which the filters and settling basins require cleansing depends upon the condition of the river water.

At some seasons it carries an enormous amount of mud, bacteria and coloring matter, while at other times it contains quite a small proportion of impurities. These conditions call for varying amounts of chemicals, according to whether the river water carries 72 tons of mud to the 1,000,000 gallons or only half a ton; whether it contains 200 parts coloring matter or only 12 parts to the 1,000,000; whether it carries 600,000 bacteria to the cubic centimeter or only 650. Thus it will be seen that the work of the chemists continues from day to day in determining just what proportions of coagulants are required. In the course of a year more than 13,500 tons of lime were used, more than 6,500 tons of sulphate of iron and 28 tons of chlorine; while the amount of mud extracted in the year was 358,000 tons.

Dry Cleaning at Home

MAKE a stock solution of eight ounces strong ammonia, one half ounce chloroform and one half ounce ether. Cork tightly and keep away from the face.

Dissolve one bar of P. and G. naphtha soap in three gallons hot water, add one half teaspoon each of baking soda, salt, and alum and three tablespoons of the ammonia-chloroform-ether mixture.

To clean oriental or other rugs to their original brightness make a lather and dip a scrub-brush in it, shaking out superfluous water. Go over the rug with this brush and the lather dries out almost immediately. No harm whatever is done to the best oriental rug.

To sponge spots from clothing, even delicate silk, and upholstery, dip a soft sponge in the lather, wring as dry as possible and sponge off the spot.

To wash sweaters, blankets or other flannels let the mixture become nearly cold, soak the garments in it half an hour or less, squeeze dry, rinse in clear water, squeeze dry and hang up.

The various ingredients used not only remove grease and dirt, but set and brighten colors.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The President on National Defense

TO every American citizen who believes that the defenses of this country should be reorganized and greatly enlarged, the recent speech of our President before the Manhattan Club in this city, was full of encouragement and promise. There can be little doubt that the discouraging attitude of the Administration during the early months of the war on the subject of military preparedness found its inspiration in the ultra-pacifism of the then-Secretary of State. Happily, he is gone, and there can be little doubt that, largely to his elimination is to be set down the recent change of attitude on the part of the Administration on this great question, which has found its climax in the forceful and inspiring speech of the President. That Woodrow Wilson realizes to the full the vast responsibilities which rest upon his shoulders as the chief guardian, not merely of the moral, but also of the material interests of the country, is shown by the following extract from this, one of the best of the many public utterances which have marked his incumbency of the Presidential chair:

"For the time being, I speak as the trustee and guardian of a nation's rights, charged with the duty of speaking for that nation in matters involving her sovereignty---a nation too big and generous to be exacting and yet courageous enough to defend its rights and the liberties of its people wherever assailed or invaded. I would not feel that I was discharging the solemn obligation I owe the country were I not to speak in terms of the deepest solemnity of the urgency and necessity of preparing ourselves to guard and protect the rights and privileges of our people, our sacred heritage of the fathers who struggled to make us an independent nation."

In such ringing words does the President call upon Congress to put into practical legislation the eloquently expressed wish of our citizens to have the country provided with adequate national defenses. Mr. Wilson has been too successful in putting through Congress the several great measures which have been passed during his régime, to leave room for any doubt that the next Congress will considerably increase our defenses, both Naval and Military.

So far, so good; but when it comes to the question of the extent and nature of the proposed reorganization, we have to confess that we ourselves, and we believe also the various organizations which have been formed to promote national defense, are at the parting of the ways. The proposed programmes, both Naval and Military, have in common a fundamental and very grave defect, namely, that they represent not the matured plans of the Naval and Military experts, who alone are fully qualified to judge in the matter, but rather the proposals of the purely civilian minds of the Secretary of the Navy and the Secretary of War. In the very nature of things, these plans must be immature and incomplete, being based largely upon theories to which no trained military mind would subscribe.

The question of the extent and nature of the forces needed is a highly technical one. It can be decided only by men whose education, experience and deep study of the subject qualify them to draw up a rational and adequate plan. Therefore, it should go without saying that the plans for the increase of Army and Navy adopted by Congress should be those which have been drawn up by specialists of the Army and Navy, who have given years of their work to the consideration of this most important subject. Thus, the General Board of the Navy after making a careful survey of the whole Naval situation throughout the world, decided many years ago that the United States Navy should be maintained in the position of second in strength which it attained seven years after the conclusion of the Spanish-American war. A summing up of the various reports of the Army Staff dealing of late years with the question of Army increase, shows a broad consensus of opinion that our land defenses should consist of first-line or regular trained troops, and regular reserves, of a combined total of half a million men, with such a second line of militia and volunteer troops as we may be able to gather.

We have so recently dealt with the Naval question in these columns, that it is sufficient here to restate our conviction that Congress should build up to the full limit of the capacity of our Government and private shipbuilding yards, until we have caught up with the programme of construction outlined a dozen years ago by the General Board of the Navy. To do this, would involve the authorization of six dreadnoughts this year, of four in each of the two succeeding years, and of three in the years 1918, 1919 and 1920. The building of first-line ships at this rate, together with the proper accessories in the way of destroyers, a reasonable number of sea-going submarines, and the proper equipment of auxiliaries, to say nothing of a proportionate increase in the number of enlisted men and officers, would bring our Navy by the year 1920 up to a condition of strength which would discourage any foreign power from crossing the Atlantic to try conclusions with us in our own waters.

We regret to say, that, as in the case of the Navy, so with regard to the Army, its civilian Secretary, in place of following the expert plans outlined by the General Staff, has drawn up one of his own, which, as was to be expected, proves to be totally inadequate. Mr. Garrison would increase the Army to 141,843 officers and enlisted men, would provide for a National Guard of 129,000, and (launching out into a sea of trouble) proposes to build up a volunteer citizen army carrying the euphemistic name of "Continentals" of 400,000 officers and men—these last to be enlisted in yearly installments of 133,000.

The futility of the Secretary's plan lies in the fact that it perpetuates the evils of the voluntary militia system—and this in spite of the fact that all American history has shown that to rely upon this is to lean upon a broken reed. Americans understand pretty well the psychology of their own temperament. They will agree that when the sinister threat of the European war has gone, with it will go the proposed "Continental" army. That struggle over, we shall return to our pursuits and our pleasures, and it is doubtful if 133 out of Mr. Garrison's supposititious yearly recruits of 133,000 will want to turn out annually for a spell of hard-tack and trench-digging.

As between the alternatives of no army and a real (not a paper) army, the country, no doubt, will prefer the latter. A practical proposal looking to this end is that of the General Staff, which asks for a standing army of trained regulars, constantly with the colors, of 200,000, and back of that a reserve of regulars who have returned to civil life of 300,000, the two constituting a trained army of half a million thoroughly trained soldiers, ready to meet and stem the first flood of invasion. This plan of the General Staff contemplates a six-year enlistment. The first two years are spent with the colors; at the end of the two years, the soldier returns to civil life, but as a reservist he is subject, annually, to a few weeks' drill in barracks and field, for which he receives pay. During the whole six years with the colors and with the reserve, he is subject to the call of his country for immediate duty in the field.

Here we have an army *de facto*, not on paper. It would be available to take the field at the very first threat of invasion, fully officered, thoroughly equipped, and amply munitioned. Back of these first-line troops, would be a second line of volunteer troops, consisting of a paid National Guard, under Federal control, and a citizen army of such size and efficiency as the practical patriotism of the people of the United States might render possible.

Germany as Nature's Competitor

AN admitted fact it is that no nation was better prepared than Germany to be isolated from the outside world and, in company with her allies, forming the group known as the Central Powers, compelled to rely almost entirely on her own resources. To her remarkable self-sustaining powers, Germany credits the Teuton chemist as having contributed in a greater degree than any other single factor. And since the German chemist has for years been establishing an ascendency over the chemists of other nations, until we have come to look upon Germany and chemistry as synonymous words in the broader sense, this would seem logical.

While fully appreciating the skill of German chemists and their numerous past achievements, it is inevitable that scientific men the world over should be rather skeptical regarding the wonderful discoveries claimed to have been scored in the isolated empire since the opening of the European war. It is inconceivable that so many problems long baffling solution at the hands of the foremost scientists of the world should suddenly be mastered in the Teuton laboratories in so short a period as sixteen months. Admitting that the very urgency of the demand for synthetic products has spurred the German chemists to a point of frenzy and the will to conquer that have been unknown to other chemists, still, the great number of achievements and their remarkableness alone would give rise to incredulity; let alone the fact that Germany has striven both openly and in secret to secure the much needed commodities from the outside world in every conceivable way.

We have heard of the new gas used in the latest super-Zeppelins which is lighter than hydrogen and positively uninflammable, eliminating at one stroke the very feature that has rendered lighter-than-air craft liable to accidental explosions at any moment, as well as most vulnerable to hostile fire; of the successful substitution of alcohol and benzol for petroleum, paper for jute, and newly-discovered formulæ for artificial leather and rubber; of the discovery of microbes that convert sugar into important life-sustaining fats; of wonderful compressed food that is at once both inexpensive and most nourishing; of explosives made from wood pulp, and other feats of chemistry too numerous too mention.

In view of the foregoing facts, the question naturally arises: Why does Germany exert every effort in her power to obtain the necessary materials and certain foodstuffs from the outside world? Is this not in direct contradiction to her boastful claims that, in German laboratories, and not on the sea and land, has the blockade of the Allies been defeated?

The seeming mystery is simple of explanation. It is safe to assume—and to some extent is borne out by the United States Consular Reports—that the achievements claimed by the German chemists have actually taken place; but, and here is the vital point, in most instances the cost and difficulties inherent to the making of the synthetic products have been so great that they limit these discoveries to the laboratory, rendering them practically valueless in the commercial sense. And in this respect the Teuton chemists are in a position that is not unique; recent years having witnessed the appearance of many substitutes for natural products, few of which ever ventured forth from the laboratory and into the commercial world, because of the cost of production.

Thus the work of Germany's chemists while commendable in the highest degree cannot hope to compete successfully with Nature and to aid the Central Powers against the enforced isolation which the war has brought on them.

Sewage Disposal at a Profit

THE disposal of city sewage is expensive and troublesome. Plants to remove the suspended matter before discharging sewage into streams are required by law in many states. Such plants are effective but also expensive.

The city of Nottingham in England has solved the problem by a sewage farm that makes a profit in addition to disposing of the sewage nuisance. About 2,000 acres were purchased a few miles from the city and the sewage carried out by one trunk line branching into smaller channels over the fields. The sewage is only partially screened, rags and large objects being removed. From the open concrete channels workmen let the liquid out into furrows made by a ridging plow between the rows, sufficient fall being allowed for. The judgment of those in charge must be the determining factor as to whether the proper amount of sewage has been applied to the crop. This is the method used for the pastures and such crops as stand such applications while growing. The crops that thrive on repeated doses are Italian rye grass, ox cabbage, mangolds and kohl-rabi and even these must attain a certain growth before treatment. The grain crops are not irrigated during growth.

"Lagoons" are filled with sewage, settled, and the sludge used as a fertilizer. Some of its value is possibly due to lime in it. Because of the large amount of water in the sewage the land must be heavily underdrained. The effluent passes into the river Trent.

There is no doubt about the financial success of the undertaking for, in the fiscal year ending March 31, 1915, the sale of cattle, farm produce, dairy products, etc., amounted to $100,000—divided up as follows: Sale of cattle, $56,900; of horses, $2,900; of pigs, $2,075; of produce, $24,700; of dairy products, $9,600 and other items of income. The net profits were $3,000 after allowing $1,000 for depreciation of machinery, and for the past three years the farm has paid.

During 1914 only 708 acres were under cultivation, divided as follows: Wheat, 100 acres; barley, 20 acres; oats, 200 acres; beans, 46 acres; potatoes, 37 acres; swedes, 35 acres; mangolds, 100 acres; ox cabbage, 25 acres; kohl-rabi, 50 acres; Italian rye grass, 95 acres. Nine hundred and sixty-four acres are devoted to pasture.

Notes on the War

Germany's Large Reserve in Men.— Sir Eric Swayne, Director of Recruiting, North of England, is authority for the statement that Germany has still from nine to ten million men between the ages of eighteen and forty-five. He admits that large numbers of these are physically unfit for the army and large numbers of others must be required as skilled munition workers; but he believes Germany must still have many millions of men who can be enlisted and trained. In view of this fact, if fact it be, Sir Eric Swayne affirms that Great Britain must enlist 3,000,000 more men by the spring if the Allies are to make sure of success.

Mine Laying by Submarine.—It is reported that the Germans are laying mines from submarines. This is perfectly feasible and is not improbable. The mines are carried one above another in a vertical air-tight chamber within the submarine. When they are to be laid, water is admitted to the chamber and a door in the outer shell of the hull closing the bottom of the chamber is opened. The mines are then released, one by one, through proper appliances. The mine anchor sinks to the bottom and, by suitable mechanism, the anchorage cable is unwound to permit the mine to float at the desired depth below the surface. This method of mine laying is absolutely secret, and therefore is proportionately dangerous to the enemy.

The Baby Submarine Idea in France.— The Paris correspondent of the *Naval and Military Record* says that in France this type is discredited. The idea of David slaying the Giant, of diminutive craft of trifling cost sinking mastodons costing many millions, has always been cherished by would-be French inventors, who, in the remarkable devices from time to time offered to the Rue Royale Admiralty, forgot one fact of capital importance, namely, that the sea is cruel to the undersized. Consequently a common tendency in craft of all classes is continuously to increase in displacement, with a view to being in a better condition to fight the sea—which is the first enemy, and an everyday one, of navigators.

The Revival of the Monitor.—One of the unlooked-for developments of the naval war has been the revival of the monitor. Particularly serviceable has it proved in the shallow waters off that portion of the coast of Belgium which is in the hands of the Germans; for monitors can operate in waters too shoal to admit the submarine. From time to time, two of these craft which had been built for Brazil and were taken over by the British Navy at the outbreak of war have attacked the German submarine base at Zeebrugge, and, by making a violent demonstration on the right flank of the German line, have materially assisted the left flank of the Allied line which is held by the Belgians. It was two monitors, also, which were sent to the East Coast of Africa, and, by ascending the shallow river where the cruiser "Koenigsburg" had sheltered, succeeded in destroying her.

An Attempt to Regain the Initiative.—Among the many interpretations which have been put upon Germany's drive through Serbia, one of the most plausible is that the Central Powers are thereby attempting to gain the initiative upon at least one of the many fronts in the field of operation. This initiative they have lost on the western front where the Allies are able to advance when they are so minded. They are rapidly losing the initiative at the eastern front, where Russia is coming back with telling blows. They have lost it also on the Italian front where, though Italy makes slow progress, the initiative seems to be hers. The very daring of the Balkan drive makes it certain that before it was started not only Bulgaria but possibly Greece had a secret understanding with the Central Powers that they were to strike on the flank of the Allies when the time for action was ripe.

Anti-Airship Defense is Difficult.—It was inevitable that the London press, subsequent to the recent Zeppelin attack, should ask why it is not possible to organize a defense which shall either intercept the Zeppelins or wreck them when they arrive over the metropolis—questions more easily asked than answered. The reasons which make it difficult for aircraft guns to reach a Zeppelin are the same in principle as those which make it difficult for a torpedo to hit a fast-moving enemy at the more distant ranges. The speed of the Zeppelin must be guessed very closely and the line of fire must be directed a calculated amount (based on its supposed speed) ahead of the Zeppelin upon which the shot is to land. Generally speaking, the difficulties due to estimating the range, or distance, are not so great, for the reason that with high-velocity guns, firing at high angles of elevation, the trajectory is almost straight for the elevation at which the Zeppelins usually operate.

Science

The Lowest Barometric Reading Ever Recorded in the United States (*i. e.*, as reduced to sea level and standard gravity) is said to have been that registered at New Orleans during the hurricane of September 29th last, when the pressure fell to 28.11 inches.

The Rockefeller Institute for the Study of Animal Diseases has recently inaugurated its work, under the direction of Dr. Theobald Smith. The institute is temporarily installed at Princeton University, pending the completion of its million-dollar home near Princeton.

Ecologists to Form a Society.—At the forthcoming Columbus meeting of the American Association a conference of plant and animal ecologists will be held, to consider the question of organizing an American Ecological Society. Persons interested in this project are invited to correspond with Prof. H. C. Cowles, University of Chicago.

Agricultural Education in Russia is being promoted by the use of demonstration cars on all the railways. According to a report published this year, the Minister of Railways has recently provided traveling lectures in gardening and bee-keeping, and is planning to lay out model gardens and apiaries near railway stations for purposes of demonstration.

The Pribilof Seal Herd at the end of the breeding season of 1915 contained about a third of a million animals of both sexes and all ages, or about 40,000 more than last year. The pups born this year numbered 103,526. The rapid increase in this herd is due to the act of Congress which has suspended the killing of seals in the Pribilof Islands, except a small number of males killed annually for food by the natives.

Agricultural Lectures for Wounded Soldiers.—Under the direction of the Imperial Museum of Petrograd, agricultural lectures are being given for wounded soldiers in eighty-three hospitals in and near the Russian capital. Patients who are able to do so are also encouraged to visit the museum, where cinematograph pictures on agricultural subjects are shown once a week.

An Heroic English Nurse at the American Hospital in Neuilly is reported in *Nature* to have inoculated herself with a pure culture of the bacilli of gas-gangrene in order that she might help in the discovery of the best treatment of that disease. Fortunately she survived the results of the experiment. Although *Nature* properly suggests that the Victoria Cross would be a fitting reward in this case, and devotes much space to a review of similar examples of devotion to the cause of science and humanity, the name of the heroine is not mentioned!

The Value of Radiotelegraphy to Vessels in Distress was demonstrated during the fiscal year 1915 in the cases of twenty-six vessels sailing from United States ports, according to a report published by the Bureau of Navigation, Department of Commerce. Except in the case of the "Lusitania," the assistance rendered in consequence of radio calls in these cases resulted in but two lives being lost. In the recent case of the Greek liner "Athinai," the passengers and crew, numbering 470, abandoned their burning vessel, and might not improbably all have perished but for the prompt arrival of vessels summoned by radio.

Dealcoholized Wine is described in *L'Italia Agricola* as a new product of the wine industry. This beverage is quite different from unfermented grape juice. It is made from ordinary wine, and contains all the components of the latter except alcohol, including the ethers and aldehydes to which its pleasant taste and stimulating properties are due. It also contains the same acids, and especially tannic acid, which has been found to exercise a protective action against the germs of cholera and typhus. The operation of depriving wine of its alcohol without any other alteration is accomplished by means of fractional distillation under relatively low pressure.

Recent Museum Groups.— The conjoined arts of taxidermy and painting are shown at their best in a series of four photographs, published in the American Museum *Journal*, for October, representing notable recent museum groups. The most remarkable is the Laysan Island bird group (shown in part), which constitutes a cyclorama at the University of Iowa. The background, painted by Mr. C. A. Corwin, is 138 feet long, while the foreground, built by Mr. Homer Dill, has an area of 400 square feet. Three years were required to mount the many birds and make the more than 50,000 artificial leaves and the grasses included in the group. The other photographs show a fur seal group, from the American Museum of Natural History, a Virginia deer group from the Brooklyn Institute Museum, and a group from the Bristol (England) Museum and Art Gallery, consisting of a tiger shot in Nepal by King George V, with a background representing the hunters on their elephants.

Electricity

Self-Starter for Aeroplane Engines.—There has been developed in France a self-starter system for aeroplane engines which is operated by electricity and weighs about 80 pounds. The motor of the system is sufficiently powerful to turn over an engine of 90 horse-power (French rating) at a speed of 50 revolutions per minute; the motor developing about one quarter horse-power. The power of the electric motor is applied to the engine shaft through a gear transmission of 38 to 1 ratio.

Germans Supply Free Electric Current to Allies.—In the *Electrical World* there is a story of how the Germans supplied the Allies with current for several months without being aware of the fact. When the Germans first occupied Lille, while the Allied troops held possession of Armentières near by, the soldier-engineers of the Kaiser's army discovered the abandoned Lille electric-lighting plant and, according to the story told by a British soldier in a letter home, shortly had the generators running and the town again lighted by electricity. It was some months, however, before the Germans discovered that the Lille lighting system was also connected with Armentières and that a good share of the energy generated inside the Teuton lines was being used to light the Allies' quarters and troop tents in the neighboring city.

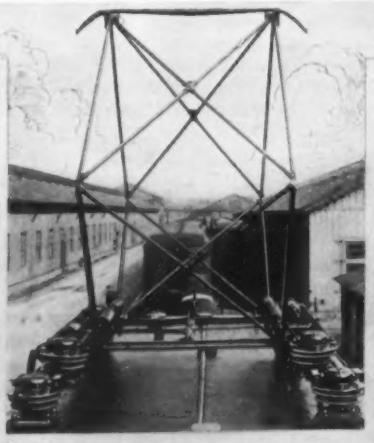
Resistance of Earth to Electric Current.—Oil in sand or earth causes it to have a very high resistance to the flow of an electrical current, while, on the other hand, certain ores in the earth cause it to have a very low resistivity. For any particular specimen of earth the resistivity varies with the moisture content. The damage to pipe systems on account of electrolysis by the return current of street railway systems depends among other things upon the resistivity of the earth around the pipes and near the tracks. In a recent publication of the *Bureau of Standards* (Scientific Paper No. 258), there is described a method for measuring earth resistivity which is free from the disadvantages of present practice. The method is particularly adapted to those cases in which it is important that the measurement be made without disturbing the earth as is necessary where a sample is taken to a laboratory for measurement, and in those cases where it is desired to measure the resistivity of a fairly large portion of earth extending to a considerable depth.

That Light is a By-Product in all Commercial Illuminants is strikingly proved by Dr. Herbert E. Ives in a table he has prepared as a result of extensive tests. In all, twenty illuminants were tried out and the figures reduced to terms of input units and the amount of visible light produced. According to Dr. Ives, the list is headed by the yellow-flame open arc, while the quartz mercury arc takes second place. At the bottom of the list are the kerosene lamp and the open flame gas burner, possessing net luminous efficiencies of less than one-twentieth of one per cent. On the other hand, the yellow-flame open arc has an efficiency of 7.2 per cent, the quartz tube of 6.8, the best gas-filled incandescent lamps of somewhat above 3 per cent and the incandescent mantle gas lamps of about 3 per cent, while enclosed arcs fall below one per cent. When the resistances that are used in conjunction with the yellow-flame arc lamps and the quartz tube lamps are considered in the figures, the efficiency drops to probably 5 or 6 per cent.

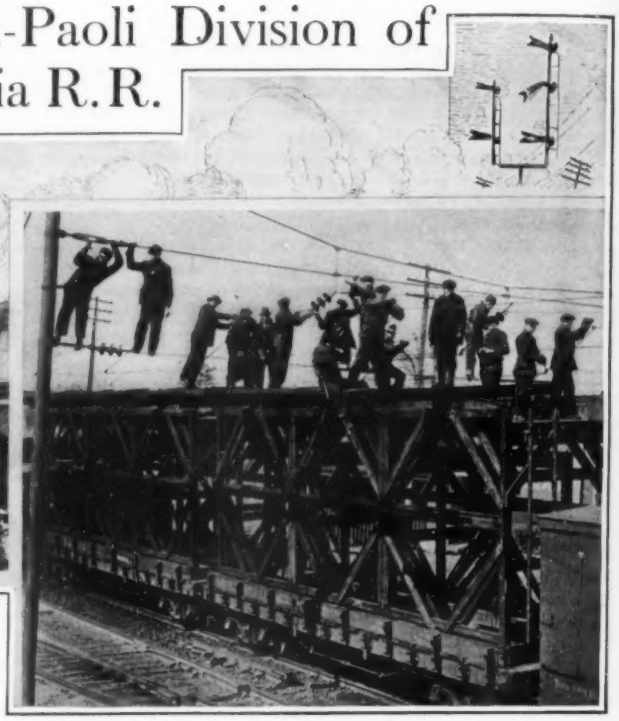
An Electrically-Illuminated Steam Curtain.—During a recent night pageant held at Lexington, Mass., in commemoration of one hundred years of peace between the United States and Great Britain and given for the benefit of the American Red Cross Society, there were featured a number of electrical effects truly startling and unique. For the illumination of the whole field where the pageant took place there were employed nine different banks of lamps; these being electric flood-lighting searchlights, each containing a 500-watt tungsten lamp and provided with variable focus mechanism. As a result of the intense illumination directed at carefully chosen angles, the players and scenery employed in the play stood out in bold relief against the surrounding blackness of the night. However, the most startling feature was a steam curtain 150 feet long and from 30 to 40 feet high, which was used to shut off the view of the spectators while the scenery of the outdoor stage was being shifted for the next scene. The steam curtain was projected by means of a pipe 150 feet in length and bored with ¼-inch holes at intervals of two feet. Steam was supplied to the pipe under 15 pounds pressure from a 75-horse-power boiler. In order to prevent the audience from seeing through the curtain, as well as to entertain them during the several minutes' time required to change scenery, colored lights were projected on the steam curtain from the rear by a thousand 25-watt lamps.

Electrifying the Philadelphia-Paoli Division of the Pennsylvania R.R.

Linemen working on a platform supported by a construction train



Pantagraph collector on roof of one of the new passenger cars



Construction train for erecting overhead wires with crew of linemen at work

ELECTRIFICATION of steam railroads has scored another triumph in the recent successful installation made on the twenty miles of main line of the Pennsylvania Railroad from Broad Street Station, Philadelphia, westward to Paoli. One of the principal objects of this electrification was to reduce the congestion in the Broad Street terminal which contains sixteen stub end tracks that converge into a "throat" of six tracks across the Schuylkill River, over which there is a total of 2,295 train movements daily. A total of eight separate movements in and out of the station is involved in the arrival and departure of a train operated by a steam locomotive, whereas with the electric trains this is reduced to two movements, the entrance and departure. The operation of local trains only is affected so far, amounting to about 15 per cent of the total train movements to the station during rush hours.

Other features of electrical operation prove to be additional advantages, such as more rapid acceleration, and freedom from smoke and cinders, the latter being particularly important as the line traverses one of the most fashionable suburban districts of Philadelphia.

The service is performed by all-steel trains composed of standard passenger coaches equipped with motors and control, each taking current from an 11,000-volt overhead conductor.

Ninety-three cars are required for this service, each equipped with two 225 horse-power, single-phase Westinghouse motors designed for a speed of 60 miles per hour on a straight level track. They are operated in trains from three to seven cars each; but the system has been planned to permit of the operation of 10-car trains when business requires.

Single-phase 25-cycle, alternating current at 11,000 volts, is supplied to the trolley which is of the simple catenary type suspended from a cross catenary between steel poles, the erection of which is shown in the accompanying illustrations. The current is collected from the overhead wire by a pantograph trolley (shown in center illustration) and led through a transformer on the car to the motors.

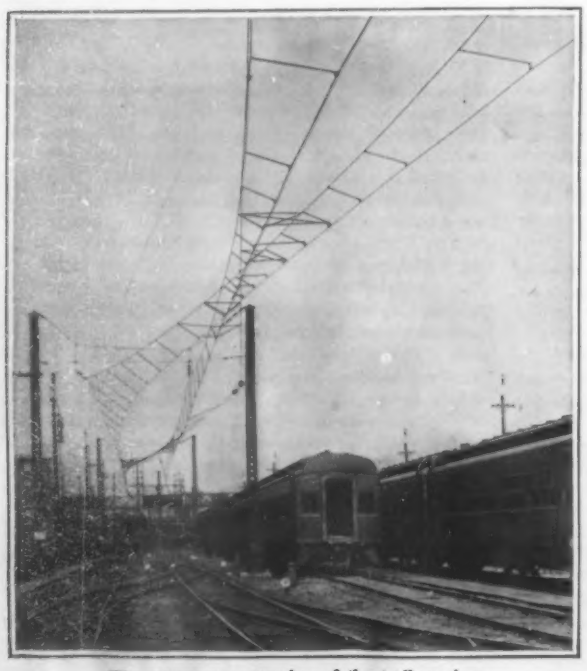
The electric energy is supplied by the Philadelphia Electric Company at 13,000 volts, stepped up to 44,000 volts, at which pressure it is transmitted to the three sub-stations where it is lowered to the trolley voltage previously mentioned.

The Current Supplement

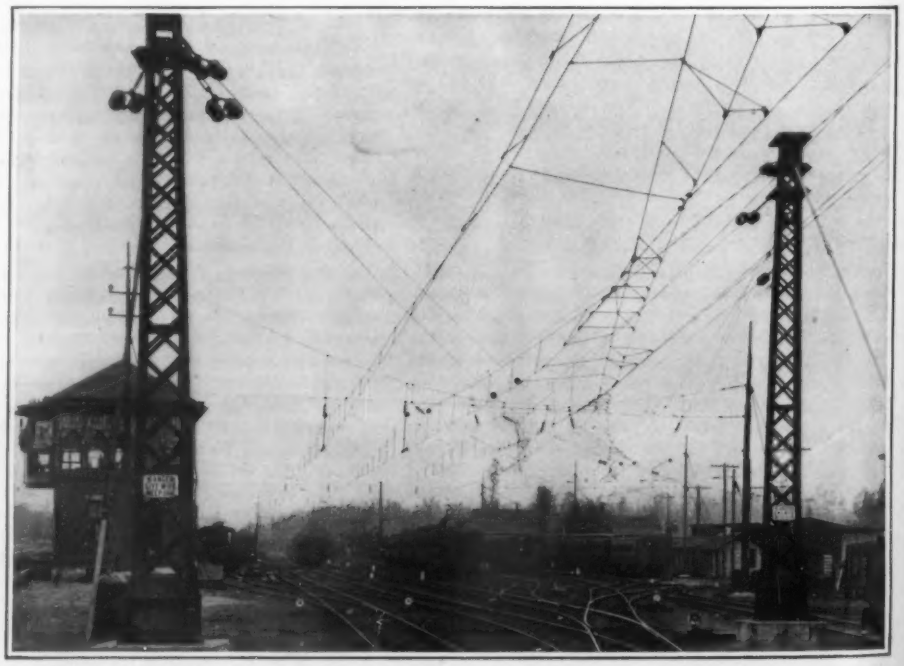
FEW people ever consider how the millions of characters that form the newspapers and books that appear daily are assembled together. A description, with illustrations of the processes, is given in *Modern Methods of Composing Type*, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2081, for November 20th. *Contact Electrification and the Electric Current* gives historical notes, and comments on various theories that have been advanced. *Titanium, and Its Effects on Steel* will have the attention of all who are interested in new qualities of steel. *Making Natural History Popular* describes some of the wonderfully artistic scenic displays at the American Museum of Natural History, illustrating our common pond reptiles, and some excellent pictures give some idea of the character of valuable instructive work that is being done at this institution. *The Passing of the Bertillon System of Identification* tells about the simpler and more efficient methods that are displacing this once famous method of criminal identification. *Man's Development Illustrated* tells of the remarkable anthropological collections at the Panama-California Exposition at San Diego, with some illustrations. It has been generally supposed that modern methods of preparing flour and bread, especially when sealed in tins, made it immune from insect life, but it appears this is not the case, as has been found from experience with army rations in Europe. The article on *Flour Moths and Army Rations* describes and illustrates a new annoyance for mankind. *Research and Progress in American Manufacture* is a timely and valuable exposition of what the scientific investigator has done, and what he can still do for industries. There are also articles on *The World's Yield of Iron and Coal, Curious Cures* and other interesting subjects.

Light from Broken Crystals

A SOFT bluish light has occasionally been seen when a scoop was scraped across solidly caked sugar in the bin. Loose sugar does not show this glow nor does granulated. The cause of the peculiar light is in the fracturing of the sugar crystals. Luminescence of this type accompanies the breaking of crystals of a number of different substances, but in none is more pronounced than in rock candy. To get the best effect place lumps of rock candy between the jaws of nut crackers or forceps and suddenly crush the crystal to fragments. If the room has previously been darkened the flash of light may be seen at a distance of 20 yards or more.



The catenary suspension of the trolley wires



Complicated arrangement of catenary trolley wires in a switching yard

Comprehensive view of the great slide at Culebra, on the west bank of the Culebra cut. Note the wavelike formation of the slide, as referred to by Col. Goethals in his report

Self-Lighting Attachment for Smudge Pots

By Charles Alma Byers

IT is estimated that there are between two and a half and three million smudge pots in use in the state of California alone, and they are also used extensively in Florida and to some extent in Colorado and other states. As, perhaps, is well known, they serve to prevent damage to orchards (oranges, lemons, olives, peaches, apples, and so forth) from frost. By their use the temperature of an orchard can be raised approximately ten degrees.

A self-lighting attachment for smudge pots has recently been invented, which is operated by a thermostat. When the temperature sinks to a point that threatens danger a fire is automatically started and the pot proceeds to perform its duty. The pot requires no attention until after it has been fired, when, of course, it must again be filled with oil and the self-lighting attachment reset.

This thermostat when contracted by the cold releases, at a certain predetermined degree of temperature, a cup of acid. This acid spills into a cup-like compartment of the smudge pot, where it comes into contact with a combustible saturated with another chemical, and fire is thus produced, which, in turn, ignites the crude oil, or petroleum, in the pot. The thermostat may be regulated to operate at any degree of temperature desired. Numerous tests have shown that it can be dependably adjusted to a half degree, and the construction is such that the cup of acid can be released only by the thermostat. The pots are constantly in readiness, and, hence, when equipped with the attachment, they comprise a kind of watchman that is always on duty. This is especially advantageous, for the reason that it is often difficult to determine just when a frost is apt to occur.

A self-lighting smudge pot

Transportable Stall Mounted on Motor Truck

WHILE the application of the automobile and motor truck has been extended to almost every conceivable phase of industrial and social life, the appearance of a motor car especially designed for the transportation of a racing horse is a distinct novelty indeed.

In order to insure the safe transportation of his famous $60,000 race horse, "Uhlan," C. K. G. Billings, the well-known horse fancier, has had constructed a special automobile. In reality, the automobile is in the form of a transportable stall fitted with every requisite for feeding and taking care of the horse while traveling, as well as for grooming it at the race track. The stall is fitted with two wheels at the rear, while the front portion is pivoted to a powerful three-wheeled motor tractor.

Concrete Shelters for Railroad Men

ONE of the more recent applications of concrete is in the form of monolithic shelters for railroad men. These substantial structures are replacing many of the conventional wooden shelters in the middle west, and are proving superior in many ways to their predecessors.

The concrete shelters are built of solid reinforced concrete; the roof, walls and floor comprising a single piece of concrete. They are made by pouring concrete into a huge mold, and upon completion are placed on flat cars for transportation to their respective destinations.

Octagonal in shape and having windows on every side, the concrete shelters provide plenty of light and air for their occupants. In winter they are warm, while in summer they are cool, so that the signal men are amply protected against the two extremes of climate. The shelters are eight feet in diameter and eight feet high. The walls are four inches thick, while the floor is six inches thick. Perhaps not the least important reason for the adoption of the new concrete shelters is that they are safer than the former wooden ones. It is not uncommon for a wooden shelter to catch on fire, due to an overheated stove, while others are sometimes crushed by a falling timber from a freight car, or entirely demolished by a car that has jumped the track and crashed into them.

Concrete shelter molded in one piece at the manufacturing plant

Copyright Edwin Levick

Famous racing horse that travels in an especially constructed motor car

Waste Heat to Stimulate Plant Growth

By Our Berlin Correspondent

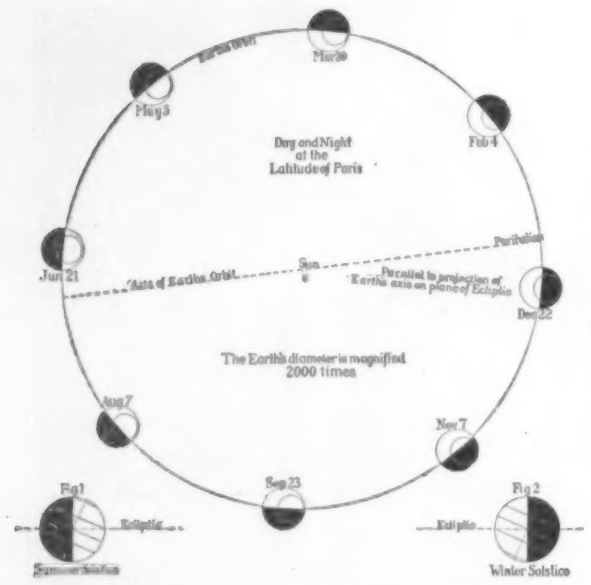
ATTEMPTS have frequently been made of late years to stimulate vegetation by electricity or radioactivity. Encouraging though their results have been, these investigations, however, did not get beyond the experimental stage.

A new departure on somewhat similar lines is now being made at the Dresden Technical High School, where plantation tests on extensive grounds heated by waste heat are in progress. Credit for the original idea is due to Chief Engineer Schulze of the same city who suggested that the output of the soil could be increased and the growth of plants accelerated considerably by a supply of artificial heat. The most advantageous plan obviously consists of utilizing to this effect the waste heat from large factories and electricity works which is now allowed to escape into the air as a useless waste product; if the heat had to be specially produced, the process, of course, would hardly pay. However, the various nursery grounds to be supplied with waste heat may very well be miles away from the place where the heat is produced. Pipes are laid out from that place, through which water at, say 50 deg. Cent., is led to the grounds and thence, after giving off its heat, back again to the works.

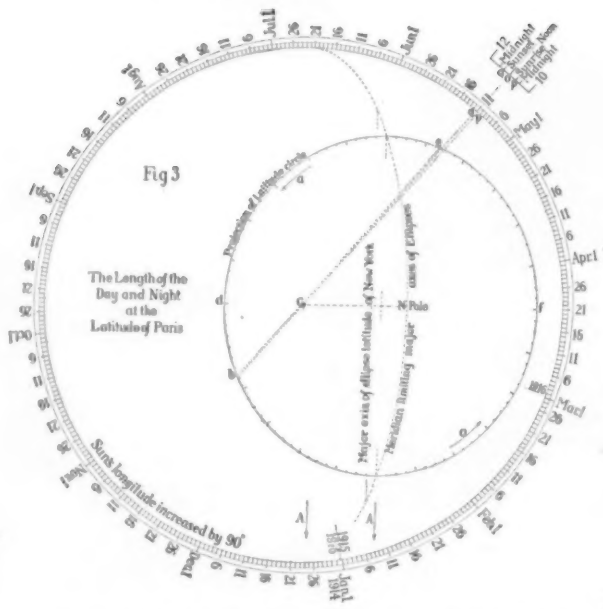
Results of the experiments so far made, according to Prof. Kübler, of the Dresden Technical High School, have exceeded all expectation, plants ripening more promptly and yielding considerably higher weights. The plants tested include maize, rye, wheat, turnip-cabbage, potatoes, soya beans and turnips. Turnip-cabbage, for instance, yields a surplus weight of 40 per cent, which not only covers expenses, but allows a material surplus profit to be obtained. Floriculture is also likely to profit by the process, thus rendering Central and Northern Europe independent of French and Italian flower exports.

Poisonous Sprays

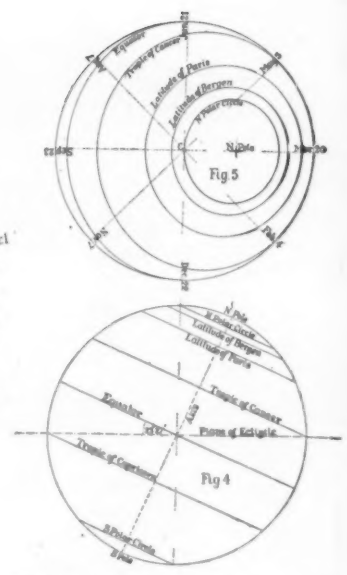
THE Bureaus of Chemistry, Entomology and Plant Industry of the U. S. Department of Agriculture are coöperating in an investigation of the quantity of poisonous elements that remain on fruits and vegetables after spraying with poisonous sprays. It is probable that some of the state experiment stations will participate in this undertaking.



Variations in proportions of daylight to night on the earth's surface at the latitude of Paris



Projection of the latitude circle and its use as a sidereal clock



Variations in length of day and night at higher latitudes

Time Measured Graphically

By Frederic R. Honey, Trinity College

THE intervals of time between sunrise and sunset, and between sunset and sunrise—which on account of the inclination of the earth's axis vary with the latitude and also with the position of the earth in its orbit—may be measured graphically. If the latitude circle be projected on the plane of the ecliptic on a scale which is large enough to represent brief intervals of time, the measurement may be made within any assigned degree of accuracy.

Figures 1 and 2 represent the earth at the summer and winter solstices, projected on a plane which is parallel to its axis and perpendicular to the plane of the ecliptic—showing the equator, the tropics, and the polar circles. Between the long day and night of about six months at the poles, and the equal division of each day of twenty-four hours into day and night at the equator, there is during the year every variation in the proportion of daylight to night on the earth's surface.

In the plot of the earth's orbit, in which the earth very highly magnified is shown at four pairs of opposite points, the latitude circle of Paris (latitude = 48.6 deg.) is selected because it more clearly illustrates than would a lower latitude the variations in the length of the daylight time. The length of the longest day—June 21st—is about twice the length of the night; and on December 22nd the night is about twice the length of the day. The equality of the day and night is shown on March 20th and September 23rd; and daylight and night in varying proportions on February 4th, May 5th, August 7th, and November 7th.

In order to compare these intervals at any date, the latitude circle is projected (Fig. 3) on a scale which is large enough to measure the time accurately. The circle is divided into 96 (= 24 x 4) equal parts; *i. e.*, each space represents a quarter of an hour which may be subdivided into minutes. It should be noted that these spaces in each quadrant of the ellipse are the *projections* of equal spaces, and are unequal; but that the corresponding spaces in the four quadrants which are symmetrical with respect to both axes, are equal.

Since the locus of an observer at sunrise and sunset—dividing the illuminated from the shadow area—is perpendicular to the earth's radius vector, the graduations on the circumference of the circle described from the center *c* are arranged to give the sun's longitude increased by 90 deg. For example, on March 21st the sun is seen in the direction of the arrows *A*; but the line *df* which divides the latitude circle into two equal parts at the points *d* and *f*, showing that the day and night are equal, is perpendicular to the radius vector.

There are three causes which combine to add a few minutes to the length of the daylight time. 1st. It is not strictly correct to say that only one half of the earth's surface which is that of an oblate spheroid, is illuminated. The sun's diameter is more than one hundred times the earth's; and as a consequence the form of the earth's shadow is conical, and the solar rays are not tangent to the surface along the circumference of what would be a great circle if the earth's form were that of a perfect sphere. 2nd. The sun's longitude—and therefore the locus of sunrise and sunset—are continually changing. For example, at the equinoxes the earth moves about a half a degree between sunrise and sunset—increasing the length of the daylight time. 3rd. On account of the refraction of light, the sun appears on the horizon before it is due geometrically; and for the same reason remains above the horizon for a brief period after it has set—lengthening the day at both ends.

How to Measure the Time

The projections of the graduations are derived from equal divisions on the latitude circle which is inclined at an angle of 23 deg. 27 min. to the ecliptic. This circle may be regarded as a sidereal clock face which rotates in the direction of the arrows *a*. One rotation measures a sidereal day; and the interval between sunrise and sunset for any day in the year (neglecting the effect of refraction which varies with the latitude) may be ascertained as follows: Rotate Fig. 3 into a position in which the date may be read without turning the head. A straight edge passing through *c* and the graduation showing the longitude will divide the ellipse into two parts—that which is nearer the reader representing the daylight time, and the other part the night. This would give the result correctly if the earth's surface were equally divided into day and night, and also if the earth were stationary. For example, on May 11th a straight edge through the center and *o*, shows that the length of the day in Paris is about fifteen hours; *i. e.*, five eighths of twenty-four hours. The points *p* and *q* give the longitude at sunrise and sunset—the distance *pq* being equal to five eighths of a space. The graduations showing the longitude at midnight, sunrise, and sunset, are magnified between the dates May 10th, 11th and 12th. A tangent to the small circle—scarcely visible in the plot—perpendicular to the earth's radius vector is the locus of an observer at sunrise and sunset. The radius of this circle is dependent upon the diameters of the sun and earth, and the distance between them. Join the center *c* with *p*, and parallel to this line draw a tangent to the circle. It is the locus of sunrise and sunset when the sun is rising at Paris and intersects the ellipse at *b*. Join *c* with *q* and draw a line parallel to *cq* tangent to the same circle which is the locus of sunrise and sunset when the sun is setting at Paris. It intersects the ellipse at *e*. Counting the number of hours and minutes between the points *b* and *e*, the length of the daylight time comes out about one minute short of 15 hours.

Figs. 4 and 5 are drawn to illustrate the great variations in the length of day and night at higher latitudes, including that of Bergen in Norway—the most northerly observatory—and the polar circles.

Transforming Sugar into Proteins and Fats

By Dr. H. W. Hillyer

TWO announcements which have come from Germany recently in regard to food supply are of very great interest. They are both statements that it is possible to produce necessary food stuffs in a very speedy fashion by factory methods.

The raw material is sugar, perhaps sugar now going to waste, and no other organic material. The active agents are microörganisms which transform the sugar into proteins in one case and into fats in the other case.

It is well known that for the growth of a yeast in a sugar solution the presence of certain salts is necessary and also that nitrogen in some form is necessary. Usually this nitrogen is that derived from the natural juice to be fermented or that derived from a decoction of other yeast; that is, the nitrogen is present in some form of organic nitrogen. But now it is shown that if nitrogen is supplied in the form of sulphate of ammonia the development of the yeast is rapid and the substance of the yeast contains at least the normal amount of organized nitrogen in the form of that most precious of all organic material—protein.

The yeast produced is found to be a good feeding stuff, for swine at least, and can take the place of grains in supplying the protein demanded as part of a balanced ration in raising swine for human consumption.

This process is of such apparent value that the Prussian state has taken advantage of a seldom used clause of the patent laws to take control of the patents granted for producing yeast on a large scale and is pushing work along this line in coöperation with the holders of the patents.

From 100 pounds of sugar and 52 pounds of inorganic salts, largely ammonium sulphate, 270 pounds of compressed yeast may be obtained. This is equivalent to 70 to 100 pounds of dried yeast. At the German price for materials the cost of the materials for the dry yeast is calculated to be about $4 per 100 pounds, and the total manufacturing cost, about $5.50 per 100 pounds. It is thought that the process will be of value in time of war, but it is granted that to be successful in time of peace it could be conducted with profit only by great factories with large capital.

Six or eight factories are to be built each of a capacity of 10,000 tons.

The fermentation which produces this new feeding stuff is carried out in an unusual manner. While the ordinary yeast fermentation to produce alcohol employs low temperatures, for this fermentation the temperature should be as high as 75 to 85 deg. Fahr. The solution fermented is made very dilute and during the fermentation a strong stream of air is blown through it. The effect of this is to prevent the formation of alcohol and to cause a very rapid development of the yeast so that the operation is complete in five to seven hours. But the great dilution necessitates immense vats and the use of air in large amounts and under considerable pressure demands the expenditure of large amounts of energy which add to capital investment and operating cost.

This rapidity of procedure and the fact that the process can be carried out in a factory and without dependence on the weather are attractive features under circumstances where a most intensive agriculture is necessary, but whether, when there is sufficient time, the same amount of sulphate of ammonia will not produce a greater amount of protein in the form of grain and straw demands further consideration.

The sugar which might be used for this purpose can be used as feeding stuff and probably to greater advantage. It is said that 50 pounds of sulphate of ammonia will give 76 pounds of dry yeast containing 50 per cent protein; that is, 100 pounds sulphate of ammonia will give 76 pounds of protein. From previous work by Maerker 100 pounds of sodium nitrate will

(*Concluded on page* 455)

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Waveless Boat

To the Editor of the SCIENTIFIC AMERICAN:

Will Mr. Hering explain why his tubular taper tunnel boat will sink when the propeller is set in motion? He seems to misunderstand "displacement." Except that at speed a boat "planes" somewhat and so reduces its displacement, the speed does not affect the displacement. The displacement of a boat is a matter of weight, not speed. That a boat in motion pushes water aside does not change its "displacement."

His design seems perfectly operable, but it would not be wholly waveless. The water would flow to the tube entrance from all directions and mostly away in a rearward direction. The incoming flow would not be parallel to the axis as would the outgoing flow and so water would pile up in front and flow away behind, which would produce a slight bow wave. The added skin friction would destroy any gain secured from the absence of large waves.

CHAS. E. DURYEA.

Philadelphia, Pa.

To the Editor of the SCIENTIFIC AMERICAN:

I have just read with interest and with some astonishment an article in your issue of October 9th describing an ideal form of vessel which is supposed to have no displacement when running through water, the explanation given being that the vessel will occupy the space between the stream of water through its center and the water outside.

If the vessel were indeed simply filling a space that would exist if it were not there, then the pressure on its sides would be zero and it would not be buoyed up. But it is just as inconceivable that an open space of that form should be maintained if the vessel were removed as it is that the space occupied by any ordinary ship moving in water would be maintained if the ship were taken away. The water around a ship of ordinary form streams back from front to rear along the sides of the ship, just as in the model proposed it would stream back through the center.

That there is displacement and a moving back of the water displaced in case of the proposed vessel is easily seen by considering the following diagram:

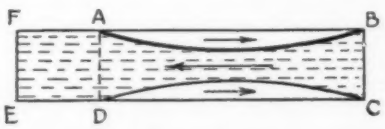


Diagram illustrating displacement of water

Before the vessel, moving from left to right, reaches the position shown, the space A B C D is occupied by a solid cylindrical mass of water; but when the vessel reaches there, part of the water will have moved back in consequence of its velocity through the middle of the vessel and will have emerged at A D, so that the water which originally filled the space A B C D is now drawn out into the form F A B C D E. There is thus a continual shifting of displaced water backwards by the current streaming through the vessel, and yet at A D the water has zero velocity as your author points out, but nevertheless there has been a transport backwards of a volume of water F A D E which represents the actual displacement of the vessel.

If there were really such a loss of buoyancy as your author supposes it would depend on the speed of the vessel, otherwise any relative motion of the vessel and water, even the slightest, would cause it to sink. That this is so can scarcely be maintained; it follows then that the boat would have to have a certain speed to lose its buoyancy, and if so what would determine that speed and what would happen if it should chance to go faster? Would it be pushed downwards?

I think we must conclude that it *still* "seems paradoxical to claim that a body of appreciable volume could be moved through water without displacing it."

ARTHUR L. KIMBALL.

Amherst, Mass.

To the Editor of the SCIENTIFIC AMERICAN:

Your correspondents, Mr. Arthur L. Kimball and Mr. Chas. E. Duryea, in their criticisms of my little article in your issue of October 9th, page 325, either did not understand me or else we used terms in different senses.

If such a vessel were completely immersed, it would of course displace an amount of water exactly equal to its volume, whether at rest or in motion; in other words, when thus immersed in a tank, the level of the water in the tank would rise. Surely no one would question this; I took for granted that this would be assumed to be self-evident, and there is nothing in my article to the contrary. In this sense of the word displacement, the vessel of course displaces water, but as I had so clearly described in the article the sense in which I was using this term, it seems to me to be little short of misrepresentation to charge me with meaning the kind of displacement described above.

To further clarify in another way, the principle of the apparent paradox described in my article, and the sense in which I used the word displacement, imagine a stream of water W in the adjoining figure, created under water at such an extremely high velocity that a ring-form vacuous space S would be formed in the water, encircling the nozzle; this of course is an extreme case used only to show the principle involved, as it might be very difficult in practice to actually form a vacuous space under water. Now if a leaden ball B be suspended in this vacuous space, from a scale, it would weigh just as much as it would in air (neglecting the displaced air when weighed in air) and would therefore *not* be reduced in weight by the amount of an equal volume of water; or if the ball were made of cork, it would *not* float to the top of the water (if it were possible to perform this experiment). And being in a vacuous space, this ball will *not* be displacing any water. I think this will not be denied by my critics, in fact Mr. Kimball admits it when he says: "If the vessel were indeed simply filling a space that would exist if it were not there, then the pressure on its sides would be zero, and it would not be buoyed up." The vacuous space formed in the water of course displaces an equal volume of water, but a body placed in this space will not, as there is no water there to be displaced by it. As soon as the stream of water stops flowing, the lead ball of course will weigh less, by being buoyed up. A ball of amber, for instance, having a specific gravity of unity, would surely sink in this vacuous space, though it would remain suspended in quiet water.

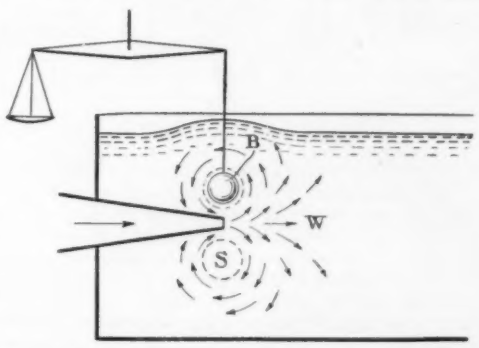


Diagram explaining the apparent paradox in the article on the boat that does not displace water

The vessel under discussion, like this ball, occupies a similar space in which a vacuum is produced theoretically in the extreme case, or which tends to be produced in practice. It seems to me that the two cases are similar, though not entirely identical.

Mr. Kimball is of course right in saying that, when such a vessel moves through water, a body of water equal to its volume must be temporarily moved away to let the vessel pass through; this was, of course, not denied in my article, as it is self-evident. But the above more detailed explanation of the sense in which I had used the word "displacement" in the article, will, I think, explain that we did not differ on this point. Nevertheless the side waves, due to moving water to the side by the ordinary boats, will surely not take place with the one under discussion, for which reason the latter might be used to advantage on canals in which the washing down of the banks by these waves places such a serious limit on the speed of mechanically propelled boats.

Replying to Mr. Kimball, if my explanation is correct, the tendency to sink would increase with the speed, being a maximum when the shape and speed are such that the space occupied by the vessel is equal to the vacuous space which would theoretically exist between the contracted column and the still water. It could not, of course, ever exceed this maximum, and I am surprised that one in Mr. Kimball's position should suggest such a thing.

Mr. Duryea evidently did not understand what was described in my article. The water would not "pile up in front" as he thinks; there would in fact be a tendency to produce suction there, hence just the contrary. It was, of course, never my thought that theoretical perfection could ever be reached; in fact my article certainly shows that it was intended merely to describe a curious case and not something that would replace all modern methods. I believe, however, that the device could be used to advantage for higher speeds on canals, on account of the absence of the side waves, and perhaps in the form of a short cross tube through the bow of a vessel for quick emergency steering, for with a positive pumping device it would seem to me that the column of water, though a fluid, would act like a strong rope, breaking only at vacuum pressures. Also, perhaps, in swiftly moving streams in which anchored chains must now be used.

There being no doubt about the facts involved in the questions concerning displacement when the intended use of that term is correctly understood, the only remaining question about which there can be any doubt is whether or not it would sink when in motion, and that is a mere incident of no importance as it could easily be avoided. But concerning this incident I could assist my own critics in their attacks if I may add here that if they had asked me about another feature which may perhaps be involved, I would have to have pleaded ignorance, but as our present knowledge of mechanics does not seem to include this feature, I am not ashamed to admit this ignorance. Some tests which I made, and which I may describe some other time, though concerning an entirely different matter, gave results quite contradictory to what a noted scientist maintained very emphatically. Perhaps these results may have some bearing on this case. If the present matter is considered to be of interest, then why does not someone who has the facilities make an actual test, and if this is really a fair and conclusive one, and shows the results as to sinking to be different from what was my first impression, no one will be more pleased to be put on the right track than the writer even though this point is merely an unimportant incident. The above two criticisms are not conclusive.

CARL HERING.

Philadelphia, Pa.

Improved Position of the Central Powers

To the Editor of the SCIENTIFIC AMERICAN:

I have read with much interest all your articles and I agree with nearly all but the last.

While I agree that numbers and supplies ought to win in the long run, I do see that the position of the Central Powers has much improved since the May drive began. At that time they may have held 15,000 miles of Russia. Now they hold at least 115,000 miles. They have also recovered at least 15,000 miles of Galicia. You see that the 30,000 miles of Serbia will soon be also in their hands, a change of something like 145,000 miles from one side to the other in about six months. Much of this territory will supply necessities to the Central Powers if they continue to hold it, and it seems difficult to move Germans from territory that once gets into their hands. In the spring nearly all this territory was furnishing men and supplies to the Allies.

The connection with Turkey and the acquisition of Bulgaria as an ally improves the position of the Central Powers also.

Numbers and supplies are still in favor of the Allies more than two to one, but I can't help seeing and you should see that the Central Powers have much improved their position since the Italians entered the war.

F. A. DE PEYSTER.

Fastest Cars in Astor Cup Race

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of September 23rd there is an article on the Astor Cup Race, recently held at the new Sheepshead Bay track. It contains the following: "Early in the race it was demonstrated that the Peugeot cars, driven by Resta and Aitken, were the fastest of the twenty starters." The above statement I have also noticed in several other publications, and I am sure it is not necessarily founded on fact.

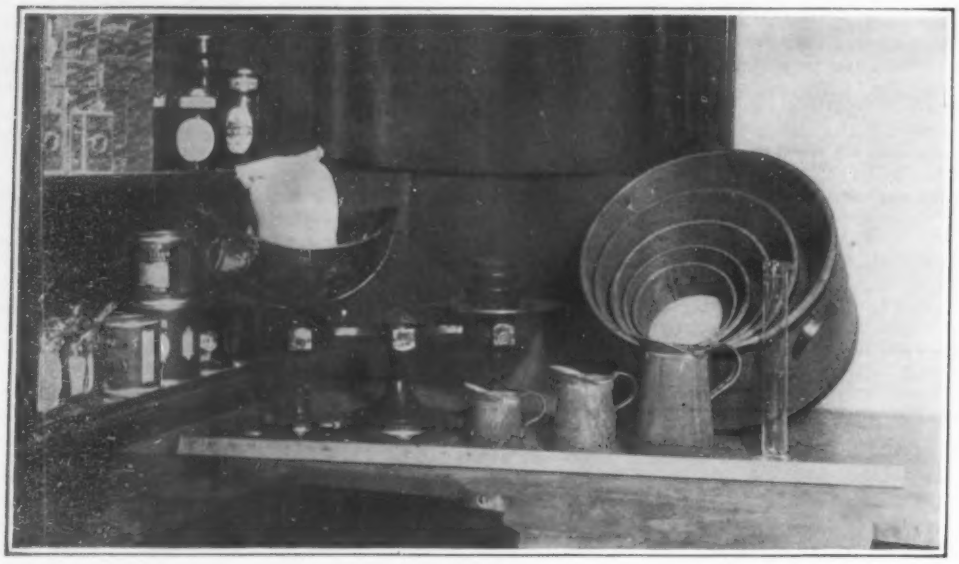
The Peugeot cars *did* run the fastest laps, and, also, their whole team of five machines *were eliminated by mechanical trouble*, broken connecting rods, cracked cylinder, and transmission trouble, due, without doubt, to forcing these cars to beyond the limit of their endurance. The drivers of the Stutz cars that won, gaged carefully what could be sacrificed in speed, held their cars to about 1 min. 10 sec. to the lap, *and finished.*

I have it on very good authority that these Stutz cars were not driven to their limit, but rather at a speed that would probably allow them to complete the whole race. Also one of the Stutz team, Cooper, in practice, has been clocked at over 109 miles an hour for a lap of two miles.

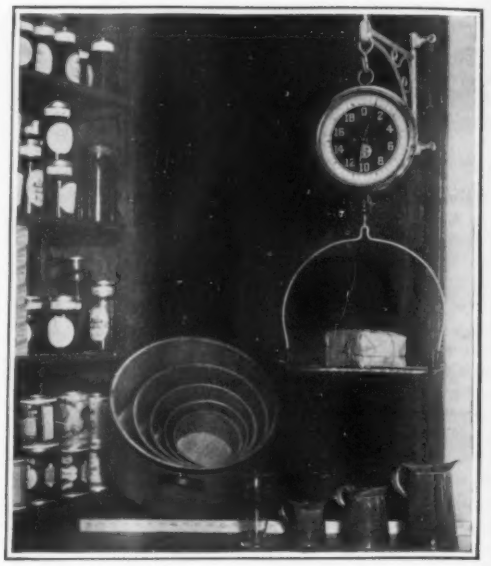
Taking the above details into consideration, I believe it is an open question as to what make of car, in the 300 cu. in. class, is really the fastest.

GEO. C. CANNON.

New Rochelle.



Household equipment of test set of weights and measures suggested by U. S. Bureau of Standards



Approved scale, dry and wet measures, and yard-stick for household use

Efficiency in the Household

Bringing Science to the Aid of Domestic Economy

By Herbert T. Wade

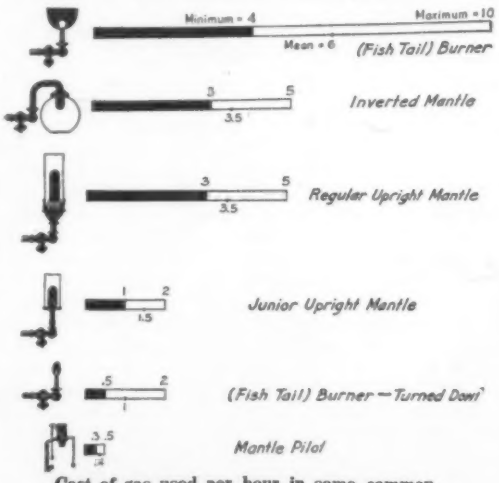
THE National Bureau of Standards at Washington is an institution familiar to scientists, technologists and manufacturers, but its relation to the average home is not as apparent. This relation, however, recently has been emphasized by an interesting publication, "Measurements for the Household," in which the dependence of domestic economy on proper and correct determination of quantities is shown. To-day, in all phases of life, efficiency is the watchword, and the elimination of waste and extravagance is no less essential in the modest home than in the manufacturing corporation or railway. This further is made important by the familiar and ever-increasing high cost of living, and improved standards and more complex relations in the daily routine of home life. If the measurement of goods purchased is short by ten per cent, or any other amount, the buyer is wasting a corresponding part of the purchase price. If this is done knowingly by the seller, an offense against the law is committed; whereas, if the consumer buys in ignorance of the amount of the commodity, or is unable to form a proper basis of comparison, he is likely to suffer correspondingly for that ignorance.

To decrease frauds and ignorance is one of the functions of modern work in weights and measures. The question of measurement in the household, however, goes much further than the mere purchase of supplies where units of length, and volume and weight are involved. Conveniences and commodities such as gas, electricity, water, light, heat, etc., though not measured directly in terms of the above units, figure in the daily economy of the home and the family budget, or are utilized in one form or another, so that to acquire them economically and understandingly, and to use them advantageously, presents many interesting problems.

The Bureau of Standards informs the householder about all the necessary measuring instruments and how their accuracy can be secured, and also explains the units and standards to which they refer, and in terms of which their readings are expressed. It also aids him in obtaining the most effective use of the various commodities or services which are involved.

The new manual is designed to bear the same relation to domestic economy as do the Farmers' Bulletins of the Department of Agriculture to the operation of the farm. It aims to teach the importance of exactness in household operations, and especially exact measurements, substituting precise quantities for the uncertain but familiar "pinch of salt," "handful of rice," "sweetened to taste," "comfortable temperature," etc., all of which may lead to excessive amounts of materials or energy, or an inadequacy not conducive to health and comfort. Accordingly, to secure exact quantities, suitable measuring instruments must be had and used correctly, and those shown in the accompanying plate are recommended for the household. If the housewife has measuring devices she is able to see that the actual quantities purchased are delivered, and discrepancies suggestive of false weights may be brought to the attention of local inspectors of weights and measures.

The consumer learns from the new manual that a yardstick or a foot rule should be either of metal or of well dried wood metal-bound at the ends, that cloth not unduly stretched should be measured between the proper brass tacks on the counter, and not those intermediate, that a spring scale (and especially one with an upper pan or platform) should be used only when checked by accurate weights, and that all weighing and measuring devices should be checked by standard measures or by certification from a competent authority.



Cost of gas used per hour in some common gas appliances

Testing a thermometer for use in an incubator

The Bureau of Standards suggests the observance in purchasing of such precautions as retaining the trimmings from meat charged for by the butcher yet not usually delivered, comparing of bulk with package goods, and demanding a sale slip specifying the price and quality of each purchase. Purchases should be made by weight wherever possible rather than by bulk or volume, as the former practice is more certain, just and accurate, and affords less opportunity for fraud.

It is not to be expected that the average householder is versed in the practices of the physical laboratory, familiar though some of the simple tests may be to the high school or college student. Accordingly, he learns that the accuracy of his thermometer may be tested as regards the 32 deg. Fahr. (0 deg. Cent.) mark by standing it in melting snow, and the boiling point, 212 deg. Fahr. (100 deg. Cent.) by placing it in steam and then making suitable corrections for the height of the place above sea level, as with an increase in altitude the boiling point of a liquid naturally decreases. The temperature of an ill person is all important to the nurse and physician, and a small error in a clinical thermometer may involve serious results. Accordingly, persons are urged to use only such thermometers as have been standardized at the Bureau of Standards or by reputable makers, where the corrections are given in an accompanying certificate. The use of the various forms of thermometers to be found in the household is explained. Thus a thermometer used in an incubator necessarily must be accurate, and the points about 100 deg. Fahr. may be tested by direct comparison with a clinical thermometer, both being placed in a bath of water heated approximately to this temperature.

The householder, however, is not merely concerned with measuring his heat accurately; he desires to obtain it economically, and to distribute it advantageously. By referring to the manual he can find the number of thermal units or the heating value of various fuels, and learn that the regulation of stove and furnace is based on scientific principles which are not always realized. The use of a refrigerator also presents many considerations. In milk kept at 60 deg. Fahr. about fifteen times as many bacteria will develop in one day as in milk at 50 deg. Fahr., and much the same is true of many other foods; therefore, it is desirable to find the coldest places in the refrigerator for milk and meat to prevent their spoiling. This is explained in a diagram showing a typical refrigerator, with the coldest spot under the ice and in the center.

The economy of light is an important consideration to the householder. The Bureau of Standards has figured out the relative cost of producing a given amount of light by various illuminants at usual prices. The familiar question of errors in gas, electric and water meters is also discussed, and the householder is informed that the great majority of meters of a well conducted company are in error by less than two or three per cent.

The Bureau in its bulletin discusses such measurements as of atmospheric humidity, the proper humidity for houses and its regulation, and the hygrometers or instruments used in such measurements; the measure-

ment of atmospheric pressure and the use of aneroid barometers therefor; and the density of liquids as given by the hydrometer which is used in the milk room and in making syrups, preserves, etc., as well as in determining the strength of the electrolyte in storage batteries so frequently found on motor vehicles and in independent electric plants. Some of the principles of horology as applied to household clocks are also treated, and the care, setting and regulating of clocks is discussed, as well as the means by which correct time is distributed throughout the United States.

Kitchen measures now are more accurate as the advances made by the domestic science departments of schools and colleges have been brought to the general home. The accompanying illustration shows suitable appliances for these purposes, based on the cup value as a standard measure of capacity, defined accurately as eight fluid ounces.

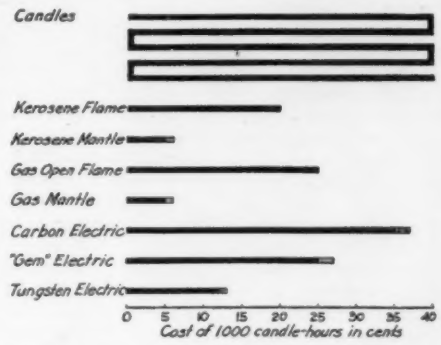
The thoroughness with which the United States Bureau of Standards has studied the applications of science to domestic economy is evinced in several of the accompanying drawings which have been selected from the circular, "Measurements for the Household." The first of these shows graphically the cost of gas used per hour in some common gas burners. The cost per hour is calculated on the basis of $1 per 1,000 cubic feet. The great difference between maximum and minimum costs is due to difference in size of burners and difference in the pressure of the gas supply. The mean value represents the cost under average conditions. For a water heater of ordinary household size the gas would cost from three to eight cents per hour. For larger automatic water heaters, gas would cost from 10 to 25 cents per hour for the period that the heater is in operation. The pilot-flame gas for these heaters would amount to one tenth of a cent per hour. Room heaters require from 5 to 12 cents worth of gas per hour. It follows that since a match costs only one tenth mill or less, it is usually more economical to turn off the gas when not in use, except for short intervals.

The next drawing depicts the relative cost of producing a given amount of light by various illuminants at the prevailing prices or as follows: Candles, 12 cents per pound; kerosene, 15 cents per gallon; gas, $1 per 1,000 cubic feet; electricity, 10 cents per kilowatt-hour. The solid lines represent the cost of fuel or of current, the shaded parts the cost of the mantles and bulbs. Where prices are different from those previously stated, the costs will be correspondingly different.

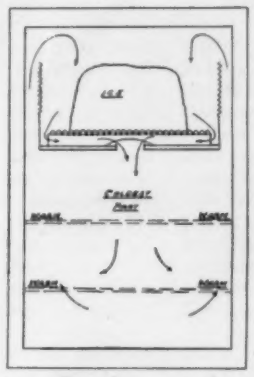
The drawing of the thermometer scales is of considerable interest, showing as it does the Centigrade and Fahrenheit scales side by side so that comparison can be made. On the Centigrade scale the freezing point and boiling point of water are, respectively, 0 deg. and 100 deg., while on the Fahrenheit scale these points are 32 deg. and 212 deg.; thus 1 deg. Cent. is equal to 1.8 deg. Fahr.

As simple as the ordinary household refrigerator appears to be to the layman, its study discloses that the process by which it maintains a low temperature lends itself to either right or wrong usage. In the more common type, wherein the ice is placed at the top, the cold air, because of its weight, sinks down through a hole under the ice and continues its downward movement among the food stored on the shelves below, absorbing heat all the while. On reaching the bottom the air is heated sufficiently to cause it to rise along the sides of the refrigerator until it again reaches the ice chamber at the top, when the process is again repeated. The operation of this type is clearly shown in one of the accompanying illustrations. In another type, the ice is placed in the rear of the food chamber, half way between top and bottom. Air entering the ice chamber from the top is cooled, causing it to sink and, turning the bend, rise through the shelves containing the foodstuffs, finally reaching the top and again entering the ice chamber to be cooled.

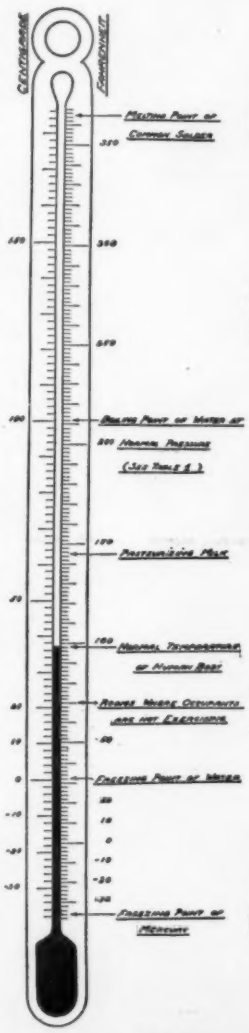
The studies made by the Bureau indicate that air entering the ice chamber of a refrigerator is freed from odors, cooled and sinks through the bottom openings, drawing air at the top. Butter, milk, and meats should occupy the coolest space, while food having a strong odor should be placed where the air is just about to enter the ice chamber.



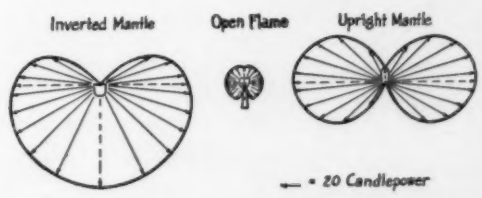
Relative cost of light from different illuminants



Circulation of air in a refrigerator

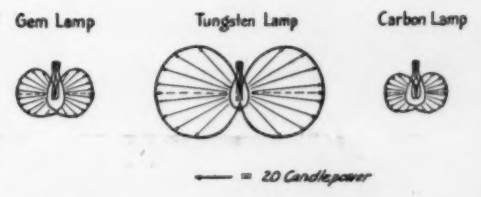


Comparison of Fahrenheit and Centigrade thermometer scales



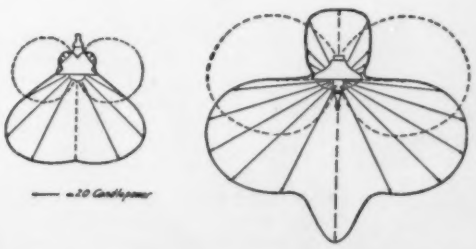
Comparison of amount of light given by different gas lamps

In this comparison each lamp is supposed to burn 5 cubic feet per hour, costing one-half cent if gas is $1.00 per 1,000 cubic feet. The distribution of the light by the three different types of gas burners is shown by the arrows, each of which is drawn in proportion to the amount of light shed in its direction.



Comparison of amount of light given by different electric lamps

As a basis of comparison it is assumed that 50 watts is consumed by each lamp. As in the case of the gas lamps, the electric lamps also vary in light distribution according to type. The distribution of the light is shown by the arrows, each of which is drawn in proportion to the amount of light shed in its direction.



Effects of reflectors in redirecting the light of electric bulb and gas lamp

Small liquid measures for kitchen use, approved by the bureau

The next three drawings relate to comparisons between various types of electric bulbs and gas burners, as well as the effects of reflectors in redirecting the light given out by lamps. The drawing showing the comparison between inverted mantle, open flame and upright mantle gas burners is based on the supposition that each is burning five cubic feet of gas per hour, costing one half cent if the gas is sold at $1 per 1,000 cubic feet. It will be noted that the mantle lamps give four or five times as much light as the open flame, and that the inverted mantle gives more light downward and less upward than the upright mantle. The ever-increasing use of electric illumination makes the drawing of comparative light given by different electric bulbs as interesting as the foregoing one. Here the comparison is based on a consumption of 50 watts for each lamp, although tungsten lamps are not usually made in this size. Fifty watts at 10 cents per kilowatt hour cost one half cent per hour. In the carbon lamp this current consumption results in 12 to 16 candlepower, while in the tungsten lamp the light given out is from 40 to 45 candlepower. Since all lamps give different candlepower at different angles, the drawing represents the distribution of the light by means of arrows, each of which is in direct proportion to the candlepower in the direction which it points.

Fully as important as the amount of light furnished by various illuminants is the use of proper reflectors, so that the drawing showing the influence of reflectors on an electric bulb and on a gas lamp is interesting. The dotted curves show the distribution of light given out by the lamps without reflectors, while the solid curves and the arrows show the distribution with reflectors. The length of each arrow is proportional to the candlepower in its direction. Although some light is absorbed by the reflectors, the light received by objects below the lamps is very much increased. The left-hand figure represents a tungsten bulb, while the right-hand figure represents an upright mantle gas lamp, both using ordinary white opal-glass reflectors.

The new circular is a distinct revelation of how useful scientific investigation is when reduced to ordinary practice, and it solves many of the questions constantly being asked in the home as regards light, heat, refrigeration, time, weights and measures, that cannot be answered simply and conveniently by the ordinary reference books available.

Popularity of Wood-Block Paving in Great Britain

WOOD-BLOCK paving is in general use in nearly all of the several hundred boroughs of the United Kingdom whose population is greater than 60,000. Its growing popularity is due to the fact that it shows a longer life under motor-bus traffic than any other smooth pavement that has yet been introduced at an equal expense, to the ease with which repairs may be made, and to the absence of dust and noise.

There are a few prominent cities, such as Glasgow, Liverpool, Dublin and Belfast where wood-block paving is not used except in front of hospitals and schools. In these cities granite sets are employed and their displacement by wood pavements is delayed because of the practice of shoeing draft horses with sharp calks, which tear up the wood blocks.

Many woods have been tried for pavements in the United Kingdom. Jarrah was introduced, but proved unsatisfactory, wearing and breaking off at the corners and edges and producing a very rutty pavement. Red gum from the United States likewise gave poor service. The use of oak was discontinued some twelve years ago on the ground of expense. Pitch pine from the United States was also tried, but it did not wear evenly and produced a rough pavement. Canadian white spruce was laid on the north side of Trafalgar Square in London twelve years ago with an eight-pound treatment of creosote per cubic foot and is still in excellent condition.

Without exception, the wood-block pavement laid in Great Britain now is Swedish and Russian redwood. Under the English specifications for blocks, hearts are admitted, also knots, unless loose or on the upper end of the block, and are sometimes accepted even then. There is no rigid adherence to any rule regarding the rate of growth. The Russian redwood is preferred to the Swedish because it is slower growing and therefore harder.

Providing a Ship with Ears

A System for Locating Other Ships and Icebergs During Fog

By Robert G. Skerrett

THE past few years have been marked by the loss of an unusually large number of ships because of grounding or collision during the prevalence of fog. Hundreds of lives have been sacrificed, many hundreds more have been imperiled, and the financial loss has been extremely heavy to underwriters and to shipowners. Isn't it possible to lessen such hazards? Must the navigator grope his way at such a time as if blindfolded—leaving his ship, her cargo, and the welfare of the passengers to the chance turn of a mere guess?

There are two problems confronting the mariner when beset by fog. If in the ordinary paths of commerce, he wants to hear as soon as possible the warning blasts of a nearing or neighboring craft, and, that done, it is vitally important that he determine the position of that unseen ship. To-day, the unaided human ear does this from the crow's-nest of the enshrouded vessel when listening for the signals of another ship's whistle. Assuming the hearing of both ears to be normal, the lookout instinctively turns his face, as he supposes, squarely toward the invisible source of sound. In doing this, the span between his ears—a matter of about eight inches—becomes the base line upon which he instinctively constructs an imaginary isosceles triangle, the apex of which is the whistle of the hidden craft. Without the aid of the eyes, it must be plain that there is much room for error, especially when the blasts come infrequently and suddenly during a period of nervous stress. As a matter of fact, it is no uncommon thing on shipboard for a number of lookouts to differ all of them as to the exact direction whence the sound comes. Upon this uncertainty hangs the welfare of the ship and all aboard.

To overcome such uncertainty Mr. Elias E. Ries, an electrical engineer of New York city, suggests using mechanical ears capable of picking up faint sounds and making these mechanical ears part of a system of sound surveying by which the position and the remoteness of the unseen source can be determined. Broadly, the receiving apparatus will consist of two megaphones, of such receptive sensitiveness that they can "pick up" the blasts of a fog horn or a steamship whistle 20 miles away. These megaphones or receivers will be attached to a spreader as long as the ship is wide, and this tube will be mounted well up on the foremast where it can be swung horizontally through a half circle. The megaphones are pivoted at the extremities of the tubular spreader and swung simultaneously toward or away from each other by means of a simple hand lever. This lever traces a pointer around a graduated arc—the graduations giving readings in miles and fractions thereof. The *modus operandi* is decidedly simple. The various functions are controlled by the lookout from his position up in the crow's-nest upon the foremast. During thick weather, he sweeps the horizon for sounds. The instant a warning is heard in either megaphone, the observer swings the yardarm around so as to get the same volume of sound in both receivers. At that time, the megaphones are probably projecting at right angles to the spreader, and the sound comes more or less muffled—a virtual counterpart of the indistinct vision one obtains through a telescope before finally adjusting the focus. Having obtained this audible balance, the lookout moves his lever operating the receivers, and gradually turns their mouths inward describing an isosceles triangle with a diminishing axis. At the moment the sound comes clearest, then the imaginary apex lying at the source of sound is automatically registered in distance upon the graduated scale. The distant sound can be heard sharpest only when the longitudinal axis of the two megaphones are pointed directly at the source of the sound. The base line length of the spreader or yardarm is great enough to afford an accurate foundation for measurements of this sort and the fact that but one ear need be used by the lookout—he can listen alternately to the sound coming from either receiver—eliminates that measure of error which would creep in if both ears had to be used and one of these were less acute than the other.

Right in the middle of his yardarm, and swinging with it, is a siren which projects its blast at right angles to this base line. Without turning the head of the ship, this horn can be pointed directly at a sound-reflecting surface when sweeping the field ahead, and while the echo may not reach the people on the bridge still it can be caught by the megaphones moving in unison with the shifting siren. In this fashion, warning reverberations of icebergs and similar obstructions can be picked up long before they are too close to be avoided.

In order to give a still greater perceptive range, Mr. Ries would turn the full length of a ship into a base line, and by mounting a group of megaphones way forward and way aft on each side he would obtain the cumulative acuteness of these several receivers—thus making it possible to drink in sounds from longer distance and, by reason of the extended base line, to locate their distant source.

Unfortunately any system based upon sound traveling through air cannot be considered infallible owing to the distortion produced by fog banks. The sound "rays" are frequently reflected by fog banks so that one can never be positive that the direction from which the sound comes in maximum intensity is the direction in which lies the sound source.

The Ries method of detecting and locating sources of sound may be considered the forerunner of the several systems for detecting invisible airships and submarines, which have been developed since the beginning of the European war. The latter systems, as in the Ries method, employ microphones at the ends of a known base line and determine the location of the sound source by triangulation.

The Lightest Known Vegetable Substance

AMONG the various economic products of the plant kingdom the pith or vegetable principle known as the medullin of the sunflower stalk is by far the lightest. The structure and formation of all piths are essentially very similar, being composed of thin-walled cellular tissue. The contents of these cells, which are all polyhedral in outline and loosely joined together, vary much in different plants; it is for this reason the pith of one plant often appears more or less different from that of another. The cells filling the interior of the sunflower stalk when young contain sap and a large number of starch grains. The starch gradually disappears as the foliage, which is in communication with the pith, becomes fully organized. After the leaves are developed, the pith soon dries up, leaving only the very thin walls of the cells. The pith in this state has a specific gravity of 0.028, while that of the elder is 0.09 and of cork 0.24.

The sunflower is cultivated to a considerable extent in central Russia, where every part of the plant is put to certain economic uses. The discovery of the extreme lightness of the pith of the stalk has essentially increased the commercial value of the plant. This light cellular substance is now carefully removed from the stalk and applied to a good many important uses. One of its chief uses is the making of life-saving appliances. Cork with a buoyancy of 1 to 5 and reindeer's hair with one of 1 to 10 have been used; the pith of the sunflower has a buoyancy of 1 to 35. The latter can be used advantageously in the construction of boats and life preservers. A sufficient quantity can be worn on a person without any inconvenience. The pith of the larger sunflower stalks is used extensively as a substitute for other materials formerly employed in making moxas for cauterizing purposes.

Smoke Pipes

OVER 20,000,000 smoke pipes are manufactured annually in the United States. The wooden pipe is probably more distinctly national than any which finds its way into the markets. Ranging in between the aristocratic meerschaum and the plebeian clay, it is rarely expensive, while at the same time its manufacture calls into existence a considerable industry. The roots of the mountain laurel and rhododendron are most generally used for pipe making, they being selected for the purpose on account of their durability, hardness, and the light polish which they are capable of taking. They are found throughout the southern states generally—the best material is said to come from North Carolina and is sent to the market in large pieces, which vary in size from that of a man's fist to the dimensions of a good sized keg. The material costs from $40 to $60 per ton, the price depending upon the quality of the wood. In addition to the domestic material used in pipe making, immense quantities of briar root blocks are shipped into this country annually from Southern France and Italy.

Correction

In the note on "The Rotation of Ganymede" which appeared on page 375 of the issue of October 30th, the statement is made that the diameter of the satellite disk is "about 1 inch .15." This is a typographical error. It should have read 1.15 second of arc, or to use the astronomical symbol 1".15.

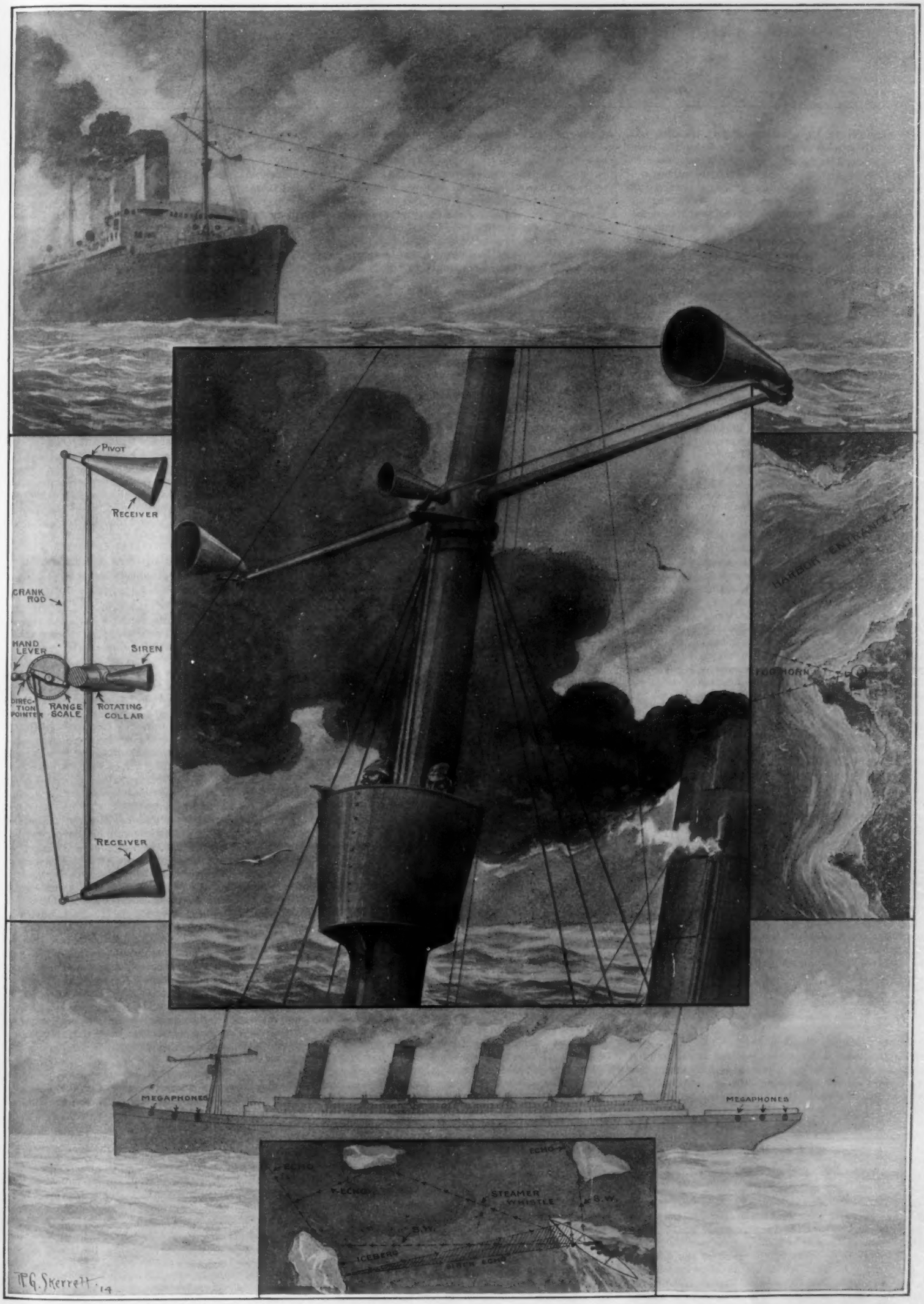
A Mile Beyond the Sunshine

CIVILIZATION is impossible without heat, lacking which we must revert to savagery. Herein lies the point wherein our kind evoluted above the beast. Cooking, the comfort of the home, the making of the infinite variety of things going into the luxuries, the culture, the decencies which, in the aggregate, mean civilized life, are impossible without a fire being made. Heat moves all this machinery, and it is by means of the coal which the miner digs out of the earth that such energizing heat is almost entirely obtained. Civilization, then, owes a great debt to that fellow mortal whose working day is spent amidst mephitic vapors and in life-danger such as obtains in equal degree in almost no other occupation, while the rest of us enjoy our place in the sun. The miner's life is indeed a peculiarly hard, a joyless, and a sacrificial one. How all too frequently have our morning papers detailed the blasting of human bodies by powder and electric shock, the horrid burnings, the suffocations by after-damp, the slow starvation in death traps, the maimings and disease of those who have fortunately escaped immediate death, while crazed women and fatherless children have gathered about the pit mouths. Nor has there ever been shown in all the glorious history of human heroisms greater bravery than has been displayed by rescue parties, members of which have frequently died with their brothers, whom they have striven to rescue. What greater love can there be than when one thus lays down his life for his brother?

Nine tenths of mining accidents occur underground, the remainder in connection with air shafts and on the surface. The casualties are chiefly due to mine cars and locomotives, to roofs falling in, gas and coal dust explosions, burning gas from underground fissures, sparks from badly insulated electric currents, defective miners' lamps. And among these causes must be mentioned the carelessness or the perversity of individual miners, who will not realize that every man entering a mine takes in his hand not only his own life, but also those of his fellows.

In such ways have lives been lost in our American mines "every year more than in all the rest of the world besides"; above 30,000 of our coal miners have been killed, and 80,000 more have been injured, during the last two decades. National regulation in European mines has enormously reduced the percentage of fatalities in them; before the war we in America have had twenty times as many killed yearly per thousand men as in Belgium or France. However, our Federal coal mine fatalities in 1914 were 334 less than in 1913, when 2,785 of our miners perished; here is, at any rate, the saving of one life and more the working day. This reduction in the number of mine fatalities is indeed commendable and forcibly illustrates what can be accomplished by proper legislation.

In our mining conditions there is indeed improvement; in large measure due to the work of our excellent Bureau of Mines in Washington. This Bureau seeks to fend the miner from danger and to improve his condition. It investigates mine gases and dusts; coal dust explosives; gas escaping from coal; the nature of accidents; what explosives are properly permissible for coal mining. It instructs first-aid parties, especially in the use of oxygen helmets. It instructs owners and their employees in the proper use of explosives, of electricity, hoists and other paraphernalia, in the equipment necessary to drive shafts and tunnels and to take out coal and minerals. Best of all it has fostered a spirit of cooperation on the part of all concerned. It has prepared an important digest of our state laws and of those of foreign nations regulatory of mine operations. It has prepared most important papers, containing detailed statements and advice which, up to the limit of their printing, are at the disposal of interested citizens. There is now more careful inspection by state inspectors. (Some years ago, an inspector, on leaving a mine gave it a "clean bill of health"; he had no sooner stepped from the shaft than one of the most awful explosions in all the history of mining occurred in that same mine.) There is now better enforcement of the laws and regulations by the operators. (They find this to pay: In 1910 250,000,000 tons of coal in Pennsylvania alone went for naught by reason of lax mining. A single fire has been burning near Summit Hill in that state, for fifty years past, with destruction thus far of above $25,000,000 worth of coal.) The passage of industrial compensation laws has also worked for improvement. Such progress as this in modern industrial hygiene demonstrates that not only "the world do move," but that civilization and humanity do move simultaneously.



Widely spaced megaphone receivers that may be turned in the direction of maximum sound intensity, thus locating the source of the sound

PROVIDING A SHIP WITH EARS

The Motor-driven Commercial Vehicle

Conducted by VICTOR W. PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any questions relating to mechanical features, operation and management of commercial motor vehicles

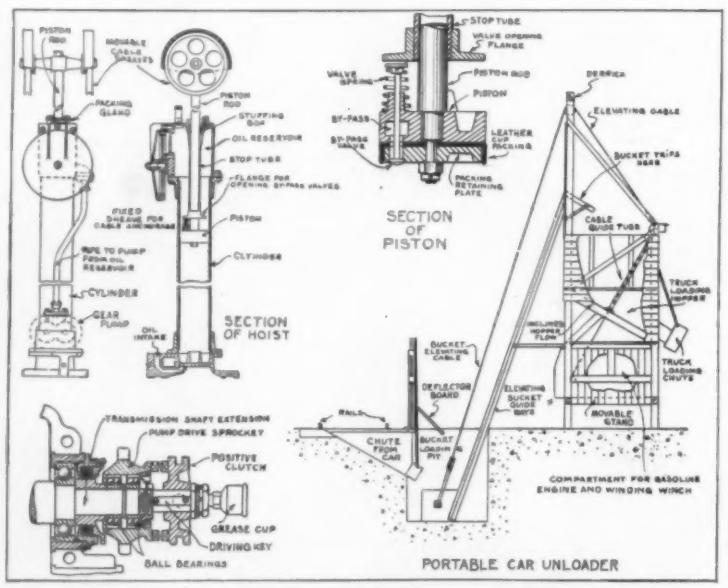
Saving Time in Loading and Unloading

ONE of the important factors making for effective and economical use of heavy duty trucks used in hauling and contracting work is that of keeping the vehicle moving. This means that rapid methods of filling the body are just as essential as having an easily manipulated dumping body where the material is of the nature that it can be handled in this manner. One of the simplest rapid loaders is shown in the accompanying illustration. This consists of a large capacity steel hopper carried by a suitable trestle and adapted to be placed at the side of the car. These hoppers are supposed to be loaded by men shoveling while the trucks are transferring their loads. When the truck completes a trip, it does not have to wait to be filled by the hand-shoveling process, which takes time, but is driven under the loaded hopper, which is tipped over and discharges its load, en masse, into the truck body. The number of hoppers needed depends upon the capacity and number of trucks used. The object is to provide enough hoppers so that the shovelers are working all the time as well as the trucks and drivers. An intelligent arrangement of hoppers and timing of the truck trips will result in absolutely no lost time for loading.

Using loaded hoppers to fill motor truck bodies quickly

A portable unloader of broken stone, sand, etc., from bottom dump gondola cars, to permit the material to be loaded into trucks without hand shovelers is shown herewith. This consists of a wooden hopper on wheels with chutes on one side for loading the trucks and a derrick operated by a gasoline motor. This hoists the material in a bucket from a pit constructed partly beneath the track into which the material is deposited direct from the car. The hopper is mounted on posts sufficiently high to allow loading into the trucks by gravity through three chutes at the bottom. Hinged legs are provided at the bottoms of the posts which are swung down to take the load off the wheels and their axles when the unit is not being moved.

The derrick frame is mounted on top of the hopper. Leading down from the base of this frame on the side of the hopper nearest the railroad track is an inclined wooden chute which extends clear down to the bottom of the pit dug partly beneath the track. A three quarter cubic yard capacity steel bucket, attached to a cable running over a pulley at the top of the derrick frame and thence down to the drum on the gasoline motor mounted beneath the bottom of the hopper, is slid up and down the inclined wooden chute. The pit dug near the track is rectangular in shape with one side sloping up under the track between two ties to accommodate a steel chute which catches the stone as it drops from the bottom of the hopper car. This chute has a gate at its lower end which controls the flow of the stone from the car.



Portable car unloader and hydraulic hoist used for operating dumping body

In operation, the bucket is lowered into the pit, the chute gate lifted and the stone allowed to run into the bucket until it is filled. The gate is then closed and the bucket hoisted to the top of the hopper where it is automatically tripped, dumping its load therein. One man can attend to the entire process, the driver of the truck opening the chute gates after his vehicle has run alongside of the hopper to be loaded. The unit is made in two sizes, of 15- and 50-ton capacities. It will unload practically any material which will pass through the bottom gates of the hopper cars furnished by the railroads. It is said to be able to handle 40 tons of crushed stone per hour at a cost, from the car to the truck, of approximately two cents per cubic yard, or slightly less than one cent per ton, figuring the weight of stone to be 5,400 pounds per cubic yard.

The hoist is the important element of the dumping type body. It must be simple in construction and easily handled. The illustration herewith shows the construction of the hydraulic hoist used by a leading American manufacturer. It is said that a hoist of this pattern made over 30,000 dumps in a year and a half without requiring any attention. The hoist is mounted behind the driver's cab, control being by a lever on front of the cab seat to throw the pump into operation, and the three-way valve, to raise, lower, or hold the body in a desired angle. The chain sprocket on the transmission countershaft revolves on ball bearings, or rather, the chain sprocket is normally stationary, while the shaft revolves inside on ball bearings. The auxiliary power shaft alongside the transmission also revolves on ball bearings. A ball bearing will operate with a minimum amount of care and attention and was adopted for this reason.

The chain between the sprockets, both in front of and behind the cab is a roller chain. No provision is made for adjusting for stretch and none has been found necessary. The sprocket at the back of the driver's seat makes a maximum of 620 r.p.m. and is prevented from going faster by a governor on the motor. The pump turns at 800 r.p.m. and is of the rotary type, the gears being each of 15 teeth, 5 d.p. and two and one half inches wide, mounted on one-inch diameter shafts. The hydraulic cylinder is made from weldless steel tubing and the end flanges are screwed on, and then a sealing of autogenously welded iron is run in a groove between the flange and the tube. This prevents all possibility of leakage. The tubes are machined and gun-reamed to a bore of five inches. The flanges are kept leak-tight by a copper gasket at the joint with the head and base. The piston, as shown in the enlarged sectional view, has the usual cup leather packing. In some of the earlier hoists, grooves in the top of the cylinder were employed, so that when the piston reached the limit of its travel the oil by-passed along these grooves. This was found to cut away the leather in time and abandoned in favor of the triple valve method shown. The piston rod is one and five eighths inches nickel steel, carrying at its upper end a crosshead on which run freely two sheaves, over which the body-lifting cable passes. A third sheave is placed at right angles to these on the cylinder head. This sheave acts as a compensating device, distributing the stress equally through the cable, and has the additional advantage that there are only two ends to the cable.

The ends of the cable are connected by yokes to substantial brackets on the front of the body, these extending downward for about two feet. In operation, oil is drawn from the cylinder head through the three-way valve, through the pump and thence under pressure to the bottom of the piston. If it is desired to hold the body in any position, the valve is turned round, shutting off the intake pipe. If the body is to be lowered, the valve is turned so the oil is by-passed round the pump from the lower part of the cylinder to the upper. It is interesting to note that the pressure of oil required to lift a full five-ton load plus the body is over 400 pounds per square inch and that the pump is working at the rate of six horse-power per minute in lifting the body up in eight seconds. An automatic stop device is provided so that the liquid will by-pass from the lower to the upper chambers even if the control lever is inadvertently left in the operating position. This result is produced when the by-pass valve stems come into contact with the valve-opening flange on the stop tube which limits the travel of the piston.

Influence of War on Industrial Transportation

MUCH has appeared in the current issues of the journals devoted to motoring of the work the various forms of trucks are performing in the war zone, but little has been said about the adjustments to meet new conditions made necessary on the part of the civilian user of trucks. As is well known, most of the large users of mechanical transports were deprived of the services of their trucks as soon as war was declared, as all of those in good running condition were commandeered by the British and French governments. The influence of the war has been felt in four ways: augmented cost of material, restricted transportation facilities, increased cost of labor and scarcity of competent men. All raw materials used in truck construction have gone up in price and, as wages have likewise increased, such trucks as are available cost more money. The cost of horse forage has increased and horses are more costly owing to the demands of the armies. Even this has a bearing on the truck situation, as many firms who formerly used horses in large quantities find that, under present conditions, motor vehicles are more economical, even the second-hand and used vehicles that are spurned by the War Department. Many American trucks have found a market in England and France, but the hazards of ocean transportation under conditions now obtaining have made their cost as high, and in some cases higher, than English trucks of equivalent rating. As practically none of the well-known foreign makes is available, the truck user is forced to buy the American product despite a prejudiced feeling against it which is fostered by all the British trade papers.

It must not be inferred that very few trucks are available in Europe as there are many that were not good enough for the authorities that are capable of giving good service in their various industrial applications. A number of contractors who have made a specialty of motor transportation have added to their fleets of trucks and are capably supplying the wants of from six to twelve firms who formerly had trucks of their own. There has also been considerable substitution of lighter trucks to take the place of the heavier vehicles needed at the front. The loss of trucks sent to the firing line is made up in a number of ways. First, by direct importation from America; second, by putting many discarded and old type vehicles back into commission; third, by using lighter types that

(*Concluded on page 455*)

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel

GARMENT.—I. SCHWARTZ, 791 Dawson St., Bronx, New York, N. Y. The invention refers particularly to sweaters, though the principle may be used with any other form of wearing apparel of substantially similar type, and has for an object to provide an improved arrangement of means for holding the sweater or other garment closed.

DRESS FORM.—L. T. FURNAS, Shirr Ruffle Co., Lima, Ohio. The invention provides a dress form with shirred ruffles for rectifying defects in the human figure, and arranged to obviate the slipping of the draw string or cord through the loop of the loop string, thus preventing the ruffle from drawing up hard when shirring the same after washing and allowing ready flattening out of the ruffle preparatory to washing.

CATAMENIAL SACK.—LOUISE M. GOODNOU, 522 W. 134th St., New York, N. Y. Use is made of a support provided with means for detachably supporting a napkin, a belt to which the ends of the support are detachably secured, protecting flaps extending outward from the sides of the support and adapted to fit the wearer, and retaining means at one end of said flaps and adapted to be passed around the wearer to be attached to the other end of said flaps.

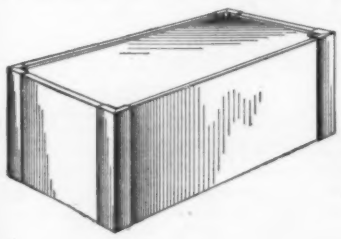
NAPKIN.—ELFREDA J. CORBIN, 3131 Girard Ave. South, Minneapolis, Minn. The object here is to provide a catamenial bandage adapted for quick and easy cleansing. The invention further provides such devices in which a sack for containing absorbent material may be folded and arranged within another sack against any possibility of accidental removal.

Pertaining to Aviation

STABILIZER FOR AEROPLANES.—A. B. THAW, 640 Park Ave., New York, N. Y. The invention provides a mechanism to selectively operate in accord with the list or tilt of the aeroplane by which it is carried; provides a mechanism with a wind motor operable by the pressure of the air through which the aeroplane is passing; provides means to maintain the ratio of stability at various inclinations of the aeroplane; provides a universal stabilizer; provides means for varying the ratio of stabilization, and provides means for varying the ratio of stabilization relative to the longitudinal and transverse dimensions of the aeroplane.

Of General Interest

BOX.—H. E. BROCK AND E. Z. MYRE, 1015 Summit Ave., Hancock, Mich. This invention reduces the necessary labor of joining; strengthens the construction; increases the wearing resistance; and provides a box which may be readily and quickly dismantled or



BOX.

knocked down and formed into a flat package for return shipments of the box. The materials from which the boxes are constructed may be varied to include wood, metal, cement and other suitable materials.

SANITARY CAP FOR DRINKING GLASSES.—J. A. CONARD, 382 Piedmont St., Atlanta, Ga. This invention provides a sanitary cap for drinking glasses to protect the contents of the glass, which cap, when fitted over a glass, will be retained thereon against accidental displacement and which will permit ventilation, but at the same time reduce the possibility of the entrance of foreign matter to a minimum.

RECEPTACLE CLOSURE.—E. A. CLAUS, 156 67th St., Brooklyn, N. Y., N. Y. The invention relates to a bottle cap having a body portion and a depending skirt adapted to engage and grip a shoulder formed in the bottle adjacent to the mouth thereof, to secure the cap in position, the body being provided with a bulge displaceable from a normal position and through the resiliency of the material of the cap controlling the position of the skirt with respect to the shoulder of the bottle.

PROCESS OF OBTAINING MAGNESIA.—J. A. BRADBURN, 311 Montgomery St., Syracuse, N. Y. This invention relates to methods or processes of obtaining magnesia from dolomitic limestone. It provides a process by means of which magnesia may be economically produced. The process will produce a relatively pure magnesia, in that it does not contain other deleterious substances.

CESSPOOL.—L. E. TERRY, care of Southampton Bank, Southampton, L. I., N. Y. The purpose of this inventor is to provide a cesspool which, while possessing in a great degree strength and durability, will retain substantially solid matter and permit the escape therefrom and drainage into the surrounding earth of substantially liquid matter.

FOUNTAIN DIVIDER.—J. THOMPSON, 572 Lexington Ave., New York, N. Y. This improvement provides a divider whereby the ink fountain of a printing press may be separated into sections in which various kinds of ink may be used without danger of the ink filtering from one section into the other or from one portion of the fountain roller to the adjacent p rtion separated by the divider.

FLOOR STRUCTURE.—W. P. FRANCIS, 83 Marietta St., Atlanta, Ga. The general objects of the present invention are to provide an improved form of slab made of cellular blocks or sections which are bonded by concrete in a novel and effective manner, whereby a slab of great strength and durability is obtained.

REINFORCED MASONRY BEAM.—W. P. FRANCIS, 83 Marietta St., Atlanta, Ga. The invention provides a beam composed of brick or other blocks laid in courses and united by mortar or other bonding material, and in the beam is a reinforcing structure of novel form, whereby great strength is obtained with a minimum of material, and whereby the bricks can be laid in an easy and expeditious manner.

ENVELOP.—O. KATZENBERGER, care of Lawson Mfg. Co., 215 W. Huron St., Chicago, Ill. This invention relates particularly to an envelop for use for second class mail matter, and provides a structure which will positively hold the matter in the envelop against accidental movement therefrom while allowing at all times an examination by postal authorities or other authorized persons.

ENLARGING CAMERA.—A. L. GATES, Cawker City, Kan. This invention relates to an improvement in enlarging cameras, and one of the principal objects is the provision of an enlarging camera of such construction that the

ENLARGING CAMERA.

negative, lens, and focusing screen or plate may be adjusted relatively to one another in order to secure a proper image and in order that enlargements of various sizes may be made.

ICE CREAM CONE BAG.—C. W. WHALEN, Millinocket, Maine. The invention comprises a collapsible receptacle, having secured or formed therein a shelf or support substantially midway between the top and bottom of the receptacle, such support being formed with one or more holes or seats to support as many ice cream cones.

Hardware and Tools

SPRAY NOZZLE.—K. MACDONALD, 506 Homer Ave., Clarksburg, W. Va. The invention relates more particularly to spray nozzles of a kind suitable for use in connection with flexible hose. More particularly stated, the invention seeks to produce a spray nozzle having such a form that when a stream of water is directed through it the stream is split in such manner that the water is thrown off laterally at a number of successive points along the general axis of the stream.

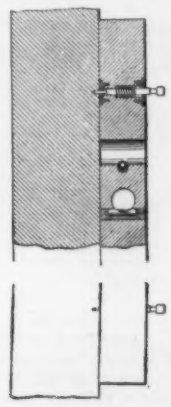
EXPANSION ANCHOR.—J. E. KEGREISZ, 35 Columbia Ave., Woodhaven, L. I., New York, N. Y. The device includes a pair of wings pivoted coaxially of each other but so constructed and arranged with respect to the main bolt as to swing away from each other and toward the outer surface of the wall, whereas the usual practice with expansion bolts is to cause the wings to swing rearwardly from the front face or surface of the wall.

EXTENSION BRACKET HINGE.—J. P. Voelker, 979 Third St., New York, N. Y. This improvement refers to hinges and particularly to an extension hinge whereby the door connected therewith may be moved out of the way when the door is opened. It provides a hinge which will minimize the space required for the door in opening and closing.

TOOL HANDLE FASTENER.—E. J. WEAVER, 07 S. Vine St., Westerville, Ohio. This invention provides a tool handle fastener chiefly adapted for employment with a wire splicing clamp, and having automatically adjustable fastening means by which the tool may be securely clamped upon a wire. It provides a fastener which may be folded out of the way when using the tool without the fastening device.

WRENCH.—W. L. BESSOLO, 12104 Euclid Ave., Cleveland, Ohio. The wrench is applicable either to polygonal nuts or to pipes or other cylindrical objects, the construction and combination of parts being such that the jaws grip the object more firmly when the leverage is applied to the handle. The shank and handle are connected by a rule-joint and the movable jaw is connected with a ratchet locking device which is adjustable on the handle corresponding to the extent to which the jaws are opened or closed.

SPIRIT LEVEL.—F. BUTLER, P. O. Box 466, Oxnard, Cal. The inventor provides means whereby it is possible to level or plumb any board, post or timber without removing the device from its first seat, providing the



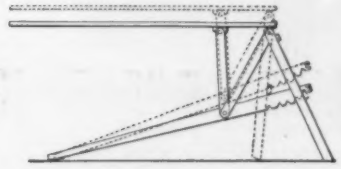
SPIRIT LEVEL.

article being adjusted has parallel faces or lines. The device may be fastened to the article being adjusted, temporarily, thus permitting the free use of both hands of the operator in adjusting the said article.

PERMUTATION LOCK.—G. ALBANESE, 16 Forsythe St., New York, N. Y. This improvement provides a lock more especially designed for use on doors, tills and others devices, and arranged to hold the bolt normally in withdrawn position, say during the day, and to allow of moving the bolt into shot-out or locking position during the night and to hold the bolt in this position without danger of an unauthorized person being enabled to retract the bolt.

Household Utilities

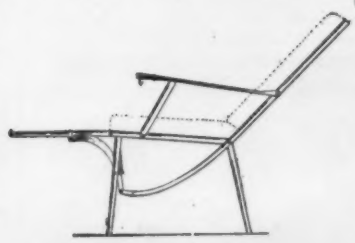
IRONING BOARD.—R. B. PALMER, 28 Gold St., Norwich, N. Y. This inventor provides an ironing board having folding supports arranged to firmly sustain the ironing board,



IRONING BOARD.

while permitting of skirts and other long articles being readily adjusted to the board. He provides folding supports that will permit the board to be readily adjusted for varying the height of the board, and will sustain the latter in a level position at the adjusted height.

CHAIR.—DR. H. H. TURNER, Northfield, Minn. This improvement relates to chairs of the reclining type. The purpose thereof is to provide a simple, convenient, strong and inexpensive reclining chair which can be easily and quickly placed in any inclined position by



RECLINING CHAIR.

the person occupying the chair, or transformed into a chair having a synchronized swinging back and leg support. The engraving shows a side elevation with the back and leg support in a position transforming the chair into a Morris chair.

ANTI-RATTLING SASH LOCK AND WINDOW STOP.—L. P. CONKLIN, 18 Bergen Place, Red Bank, N. J. The invention relates to improvements in locks employed in connection with window sashes; and the main object is to provide a sash lock which can be made to do service as a window stop. It provides a self-locking sash lock positive in operation and of a simple and durable construction. It also provides a sash lock which will hold the sashes to the window frame to prevent rattling of the sashes.

CLOTHES STICK.—ANNA S. TAYLOR, 525 W. 124th St., New York, N. Y. This stick is more especially designed for safely handling clothes, especially lace and other delicate garments, when placing the same into a wash boiler or tub or removing the same therefrom, and to allow of conveniently supplying the wash water with a washing compound such as bluing, shaved soap, washing soda, washing powder or the like.

COLLAPSIBLE AND PORTABLE TOILET SEAT COVER.—A. RIVERA, Sonsonate, El Salvador, Central America. The invention provides an auxiliary sanitary cover which may be used in connection with toilet seats of ordinary and various special construction, the auxiliary seat or cover being so constructed that it may readily be folded for transportation and when so folded will occupy a minimum amount of space so that it may readily be carried in a satchel or grip.

GRATER FOR CULINARY USE.—G. ALBANESE, 16 Forsythe St., New York, N. Y. This inventor provides a grater more especially designed for household use for grating pieces of cheese, bread or other soft materials and arranged to enable the user to grind the piece to the last portion without danger of cutting or injuring the fingers and to permit of convenient cleaning of the grater.

ELECTRIC COOKING STOVE.—A. O. CHRISTENSEN, 86 Randolph Ave., Dover, N. J. This invention comprises an electric stove designed for use in cooking, having a heating coil exposed on the upper side of the stove and a second coil embedded a little below this first named one in a refractory material, such second coil being for use in series with the first coil, thus serving as a resistance to the flow of electricity in the first coil.

Machines and Mechanical Devices

PEANUT THRESHING MACHINE.—C. R. LIVERMON, Roxobel, N. C. The invention provides a device by means of which the peanuts may be stripped from the vines and delivered in a perfect condition. It provides a device which will not tend to clog up, but in which the vines are so treated as to be kept from clogging up the machine and thereby delaying the operation of the device.

HYDRAULIC VALVE.—A. L. GRANDSTAFF, Box 395, Steubenville, Ohio. This invention accomplishes more thorough control over the motor by the operator; makes use of merely a single inlet opening to be kept tight; enables the inlet valve to be operated by aid of mechanism completely housed within the inlet chest and hydraulic valve casing, so that practically the only movable part protruding is a single hand lever; and enables the hydraulic valve and its movable parts to be easily controlled, owing to the fact that the fluid is admitted through the single inlet valve.

BARREL FEEDING AND ARRESTING DEVICE.—H. REININGER, care of Consumers Brewing Co., Clio and Liberty Sts., New Orleans, La. This invention provides a device which will receive a barrel, keg, or the like, and feed the same to a proper point and then arrest the same with the bunghole in a predetermined position so that the barrel washing and rinsing machine associated with the device may properly act on the barrel.

BAND CHUCK.—M. D. HEYMAN, 192 S. 1st St., Brooklyn, N. Y., N. Y. The immediate holding portion of the chuck is a flexible circular band adapted to snugly engage practically all the way around the work being turned, whereby all danger of damaging the work by crushing, indenting or otherwise marring the same will be avoided.

PROCESS AND MACHINE FOR MAKING BRICKS.—E. H. RODGERS. Address El Paso Brick Co., El Paso, Tex. This invention has reference to an improvement in brick machines, and more particularly to an improved means whereby the clay ribbon may be corrugated or channeled and subsequently treated in producing bricks having a "textile" finish.

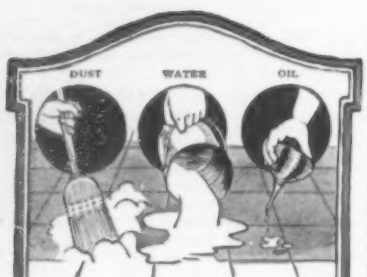
FEEDING MECHANISM FOR SLICING MACHINES.—H. FISCHER, care of Van Ingen, 1081 5th Ave., New York, N. Y. The mechanism is more especially designed for slicing loaves of bread or other foodstuffs by the use of an ordinary knife wielded by the operator, the machine providing a guide for the knife, a plate for the bread, and manually controlled means for imparting a step by step movement to the plate, the throw being variable according to the desired thickness of the slices.

DOUGH MOLDING MACHINERY.—J. E. POINTON, Westwood Works, Peterborough, Eng. This invention relates to the molding or like treatment of dough such as is used, for example, in the production of what are known as tin or pan loaves (from the fact that they are baked in tins or pans), or any other type of loaf which is flattened, folded and rolled.

CARTRIDGE STOP FOR MAGAZINE SHOTGUNS.—F. MOENCH, Rushville, Ill. This invention is an attachment applied to, and beneath, the magazine or cartridge tube and includes, as a principal feature, a series of spring catches that engage the flanges or rims

CARTRIDGE STOP FOR MAGAZINE SHOTGUNS.

of a corresponding number of shells, but which may be released by manipulation of a slidable trip device. The trip and the hand grip are independent of the breech mechanism, the latter being operated by other means.



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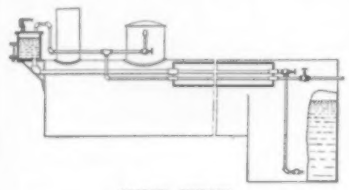
Musical Devices

MUSIC LEAF TURNER.—D. THORNTON, 36 Yonkers Ave., Yonkers, N. Y. An object here is the provision of an improved construction which may be readily operated by a single finger operated device or a foot operated device, according to whether the device is used on a piano or other similar instrument or a stand.

Prime Movers and Their Accessories

BOILER FEEDER.—J. M. ABBOTT, Pittsfield, Ill. This inventor provides a device adapted to be connected to a boiler of any character, and wherein mechanism is provided



BOILER FEEDER.

comprising a reservoir adapted to be connected with a source of water supply, and having connections with the said source and with the boiler, and having other connections with the steam dome of the boiler for enabling the reservoir to be filled from the source of supply and to be emptied into the boiler, by steam pressure.

WATER MOTOR.—O. H. OLIVE, 308 E. Ashland Ave., Indianola, Iowa. The improvement relates more particularly to a water motor including a plurality of water wheels, the construction of each of which wheels, and the relation between which wheels, are such as that the impact elements of any one of the wheels cannot destroy or impair the effect of the current upon those of the other wheel or wheels.

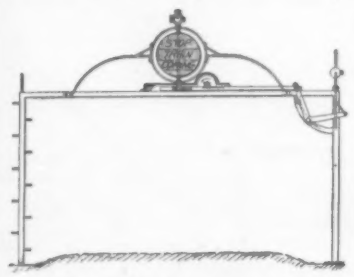
Railways and Their Accessories

AUTOMATIC STOP FOR RAILWAYS.—J. G. SPARKS, 1490 E. 2nd St., Brooklyn, N. Y., N. Y. In the present patent the invention has reference to railway equipment and has particular reference to safety appliances serving to prevent the possibility of a train running past a danger signal or open draw by reason of the carelessness or disability of the engineer.

CAR COUPLING.—J. DRISCOLL, Gypsum, Kan. This improvement provides an efficient coupler which will couple automatically and which can be easily and quickly uncoupled from the exterior of the car provided with the coupler by applying pressure to the coupler at a proper place provided therefor.

JOURNAL BOX.—F. A. MCGUIRE, Iola, Kan. This invention relates more particularly to an arrangement for providing an auxiliary oil supply for the journals. It provides a journal box having an auxiliary oil reservoir or cup therein adapted at a predetermined temperature to discharge its contents into the box for lubricating the axle journal.

RAILWAY AND HIGHWAY SIGNALING DEVICE.—A. H. MESSER, 212 Clark St., Mankato, Minn. This invention provides a device which will simultaneously operate a semaphore placed along the track and a highway signal disposed adjacent thereto. It further provides a combined highway signal and semaphore oper-



RAILWAY AND HIGHWAY SIGNALING DEVICE.

ating device which is simple in construction and which is therefore not easily liable to get out of order. The device is positive in action and will require little or no attenton or adjustment for a considerable length of time.

RAILROAD SKATE.—A. TAYLOR, 1506 S. Locust St., Centralia, Ill. The invention provides mechanism in connection with the tracks of a gravity or hump switch, for permitting the operator in the tower to place the skates on any branch or track of the yard, thus dispensing with the services of the usual operative, and insuring that the skates will be put on the proper track, and in time to stop the car or cut of cars in ample time.

Pertaining to Recreation

GOLF CLUB.—ROBERT H. DAVIS, 175 5th Ave., New York, N. Y. This invention is adapted for embodiment in golf clubs of various forms and has for its prime object the production of a golf club that will enable the player to drive a golf ball a materially increased distance and with greater accuracy by a blow of given force as compared with the results obtained with golf clubs of the ordinary form.

SLEEPING EYES FOR DOLLS.—O. E. DENIVELLE, care of Denivelle Co., Inc., 42 Wooster St., Mt. Vernon, N. Y., N. Y. The aim in this case is to provide sleeping eyes for dolls, arranged to permit each eye to move into open or closed position independently one of the other, to insure free movement of the eyeballs, and to allow of manufacturing the eyes very economically.

TRICK WRITING IMPLEMENT.—A. MEYER, Stallschreiberstrasse No. 58, Berlin, Germany. In this instance the design consists in a trick writing implement serving as a device for a practical joke, which is constructed in such a manner that when used for writing it falls apart, owing to the action of a spring, and in this way creates a surprise.

WIND WHEEL TOY.—K. NAITO, 2105 Boardwalk, Atlantic City, N. J. This invention comprises a plurality of oppositely-rotating disks, one of which has a colored face, and the other a number of sight openings therethrough to permit the colors on the first disk to be viewed. The disks are operated in opposite directions by wind vanes, and, when in rotation, different visual effects are produced upon the observer looking through the openings on one disk at the colored face of the other disk.

Pertaining to Vehicles

AUTOMOBILE TRAILER COUPLING.—J. A. SCHARF, Richwood, Ohio. Among the objects of the invention is to improve this device whereby an automobile of any design, make or type, may be drawn in the rear of another automobile, the machine being so drawn not requiring any attention for steering purposes or otherwise independently of the control of the traction vehicle.

WAGON WHEEL.—W. F. JARRETT, Carl Junction, Mo. This invention relates more particularly to wheels which are formed with wooden spokes and rims which are therefore subject to atmospheric conditions and affected or influenced thereby. The object is to provide a wagon wheel in which the spokes may be tightened from time to time as circumstances may necessitate.

ENGINE STARTER.—R. A. STABLER, 309 W. Penn St., Muncy, Pa. A driven member is applied to the engine shaft, and a manually operated drive means gives a turning movement to the driven member. A spring returns the drive member to initial position after a forward movement. Ratchet elements establish the driving connection between the drive means and the driven element, and associated with the ratchet elements is means to throw out the ratchet connection automatically in the event of back fire.

COMBINATION HOOD FOR AUTOMOBILES.—D. MCR. LIVINGSTON, 159 36th St., New York, N. Y. This improvement refers to a combination motor hood and radiator hood for automobiles, and is more particularly intended for use on Ford cars, although not limited in all its features to use on this special car. The hood can be applied and removed with great facility, so that no skilled workmanship is required, nor alteration of the standard parts in the machines to which the invention is applicable.

AUTOMOBILE BODY.—JOHN E. MANZEL and J. A. LYONS. Address the former, 188 Wickham Ave., Middletown, N. Y. This invention provides for exposing the operating mechanism of an automobile, which is usually covered by the body thereof; provides means for condensing the storage space for automobile bodies; and provides a body for automobiles so arranged that the forward and rearward half sections may be lifted and folded each upon the other.

ARTILLERY WHEEL.—H. E. FLICK and L. W. LONG. Address the latter, 1217 E. Main St., Jackson, Mich. This improvement provides an artillery wheel with a metallic felly comprising sections of novel construction and connection so as to render the wheel extremely strong and durable and capable of withstanding considerable rough usage after being assembled and trued.

ELASTIC WHEEL.—E. AIMOND, 21 Rue Chaptal, Paris, France. The invention relates to elastic wheels of the type in which the hub is suspended within a ridge rim by means of an internal ring which can yield relatively to the hub and to the rim and is connected to these parts by two series of radially arranged springs.

TIRE TOOL.—FRANK SEVISON, Muncy, Pa. The invention relates to tools for use in enlarging a cut or puncture in a tire for the purpose of applying a patch. The main object of the invention is to provide a tool whereby to enlarge the cut or opening in the tire without inserting the tool in the cut or opening.

TRACTOR WHEEL.—J. BEARD, Two Rivers, Cal. The invention relates to the type of tractor wheel forming the subject-matter of the United States Application Serial No. 816,738 filed by Mr. Beard. In the present invention he provides an arrangement of the gear elements and track sections, whereby said track sections will embrace and house the gear elements to a practical extent, whereby to exclude grit, etc.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Transforming Sugar into Proteins and Fats

(*Concluded from page 446*)

cause an increase in the yield of wheat equal to 300-400 pounds. Sulphate of ammonia is regarded as having a nitrogen value nearly as great as that of sodium nitrate. The protein content of wheat is only 9 to 18 per cent, or, taking 12 as an average percentage and 300 pounds as the average increase in the yield of wheat by the use of 100 pounds of ammonium sulphate, the gain in protein by this use of ammonium sulphate would be only 36 pounds, or only about one half the gain in producing yeast by the new method. Attention must be called, however, to the fact that all nitrogenous vegetable products are not available as foods and indeed may be poisonous. The last suggestion is apparently not according to the facts, as the yeast is used as a feeding material, but it is too soon to know definitely what is the actual feeding value of the proposed feed.

The *Chemiker Zeitung*, of October 23rd, which gives the latest news on this matter, also announces another interesting discovery in the application of yeast to industry. Prof. Lindner received a new microörganism from one of his former students, then fighting in the trenches in Poland. On investigation, the organism was found to be a yeast which under certain conditions was very rich in fat. Ordinary yeasts may contain three to four per cent of fat, but the new yeast contains 18 per cent fat in the dry substance and besides this some 30 per cent of protein. The question as to where to get a sufficient amount of fat for food and other purposes seems to be a crying question now in Germany, and, consequently, this last discovery may be of considerable present importance. Since the sugar from which the fat must be made by the yeast is so nearly an equivalent for fat as a food material, it would appear that the production of fat in this way can hardly be as important in the national economy as the production of protein by the other fermentation.

Influence of War on Industrial Transportation

(*Concluded from page 452*)

are not so well adapted to the business as those requisitioned by the authorities, and, fourth, by hiring some contractor to handle the delivery problem. Of course, there are many lines of business that have suffered because of the war and this has made the use of small trucks desirable and practical in these lines.

The greatest difficulty is not in securing vehicles enough but to obtain men skilled as drivers. Before the war, there were plenty of good chauffeurs, now the quality of labor available for that purpose is far from the best. The motor transport division of the army has most of the good drivers enrolled. Some firms who would not hire drivers unless they had at least two years' previous experience are now forced to take almost anyone who will present himself. The dearth of good drivers is so marked that efforts are being made to have women drivers on lighter cars to release able bodied men who can be used on the larger trucks which youths, women or old men are physically unable to master. While women drive fully as well as men, they have no mechanical instinct and most of them are helpless when mechanical faults must be remedied. It is not likely that many women will undertake this kind of work, though some who have driven cars of their own and who are financially embarrassed may undertake the work temporarily as a means of earning a living by filling some of the gaps left by men needed at the front. Wages of drivers have risen 10 to 15 per cent and, in some cases, bonus systems are being tried to counteract some of the inevitable defects resulting from the employment of untrained men. The bonus systems are based on increasing earning capacity and, as the vans must be maintained in good condition to obtain the bonus, even the unskilled driver becomes interested and endeavors to learn more about the machine he drives and how to care for it.

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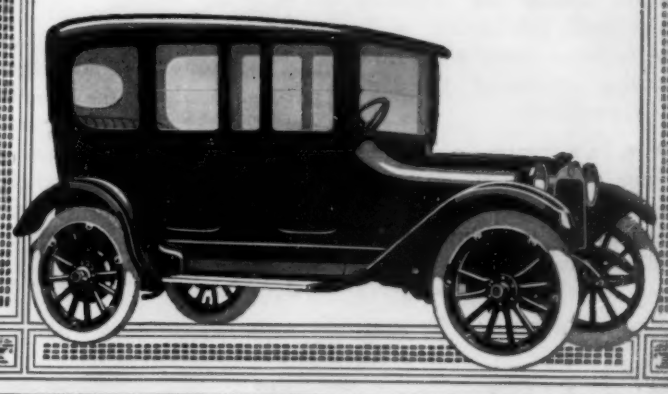

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THE MECHANISM OF MENDELIAN HEREDITY. By T. H. Morgan, A. H. Sturtevant, H. J. Muller and C. B. Bridges. New York: Henry Holt and Company, 1915. 8vo.; 262 pp.; illustrated. Price, $3 net.

In a commendable effort to separate the vital from the purely technical, the authors of the volume in hand present heredity as a problem involving the cell, the egg and the sperm, rather than as a cold mathematical formula. Their work follows generally along accepted lines, unless it be in their attitude toward the chromosomes; upon these they place the burden of the material basis of inheritance, leaving the future to vindicate or to overthrow their belief. However, their adherence to this theory is not allowed to so interfere with such a presentment of questions and of results that the value of their work is dependent upon the theory. Not only do the chromosomes offer just that mechanism which the Mendelian laws demand, but, the authors point out, an ever-growing mass of reliable knowledge indicates more and more decidedly that the chromosomes are bearers of the Mendelian factors.

THE CALLENDAR STEAM TABLES. By H. L. Callendar, F.R.S. New York: Longmans, Green and Co., 1915. 8vo.; 40 pp. Price, 80 cents.

These tables are based upon the intensity of gravity in London at sea-level, and their values are tabulated on three systems—Foot-Pound-Centigrade, Foot-Pound-Fahrenheit, and Kilogram-Meter-Centigrade. The tables are abstracted from a larger work, "The Properties of Steam," by the same author, and are founded upon experimental measurements of the specific heat of water and the mechanical equivalent, of the specific heat of steam by the author's continuous electric method, of the adiabatic index with a compensated platinum thermometer, and of the Joule-Thomson cooling-effect with a differential throttling calorimeter. A folder of the Callendar steam diagram is furnished with the work.

MICROBES AND MEN. By Robert T. Morris, M.D. Garden City, N.Y.: Doubleday, Page & Co., 1915. 8vo.; 539 pp.; illustrated. Price, $2 net.

At the door of the microbe Dr. Morris lays most of the world's misery, physical and mental. A man, he says, is only what his microbes make him. This is of course a hobby that may easily be ridden too hard, and the author's application of his theories are occasionally speculative rather than demonstrable. His charmingly discursive work has, however, such a penetrating knowledge, both of microbes and of men, that its most speculative portions have an inspirational value, a quality that shakes the slothful mind into wakefulness. It runs the alphabetical gamut from alcohol and apartment houses to Wagner and Zola, from art, beauty and genius to sex, thought and warfare. Obviously such a work lends itself unwillingly to the limitations of a brief review, but its optimistic if somewhat material philosophy may be recommended to any educated reader, whether he reads for solid information or merely for the enjoyment that the author's characteristic style and expression cannot fail to impart.

SHRAPNEL AND OTHER WAR MATERIAL. A Reprint of Important Articles Presented in the *American Machinist* from January to June, 1915. New York: McGraw-Hill Book Company, Inc. 4to.; 96 pp.; illustrated. Price, $1.50 net.

The interest manifested in the industrial and technical aspects of the war makes especially timely this reprint in book form of articles dealing with every phase in the manufacture of shrapnel. The work tells exactly what shrapnel is and does, and describes at length the operations followed in turning out the British product, explaining the differences between French, British, and German shells. The illustration is lavish, and shows the various types of shell, the evolutionary stages of the work, and the machinery used. Much of the latter is automatic, and of most interesting construction; its general appearance is conveyed by photographs, and the details by mechanical drawings. The reader is taken through the Canadian shops, and the story of the magical transformation of peaceful manufactories into munitions plants is a feature worthy of remark.

HOW TO MAKE AND HOW TO MEND. By an Amateur Mechanic. New York: The Macmillan Company. 8vo.; 294 pp.; illustrated. Price, $1.

This alphabetical arrangement of methods and recipes will appeal to any boy or man who takes an interest in his home and his garden. There are simple burglar alarms, bell instalments, and all sorts of conveniences for the house; implements and accessories for farm and garden; balloons, kites, boomerangs and sleds for the children; clamps, mitre blocks, kennels and rustic work for the amateur woodworker, and countless recipes for the housewife. The best ways of caring for brushes, bicycles, tools, and machinery are described, restorations and repairs of every kind are suggested, and simple processes such as dyeing and electroplating are explained. The average man will find this compendium of ways and means a saver both in money and in convenience.

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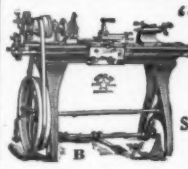

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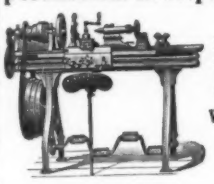

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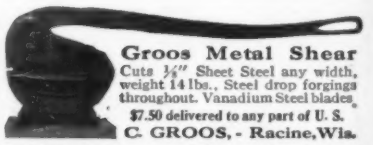

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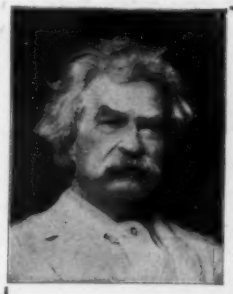

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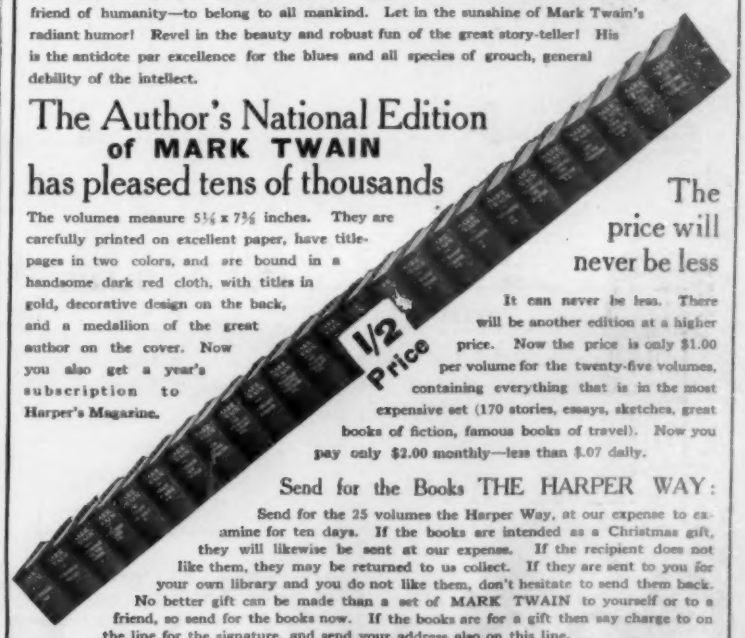

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